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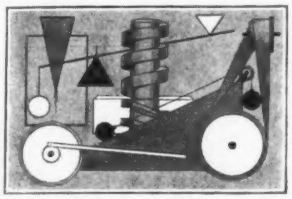

Next MONTH

BECAUSE the design of all machinery is based upon a few fundamental concepts, the editors of MACHINE DESIGN have asked Professor Martenis of the University of Minnesota to prepare a treatise on the application of mechanical principles. This timely re-statement of the very foundation of the design profession will appear in the October issue.

Among other practical articles will be a discussion of the properties and applications of gray iron, by John W. Bolton, one of the foremost authorities on the subject. John F. Hardecker will continue his series on the organization and supervision of a design department.

L. E. Jermy

Managing Editor

CONTENTS

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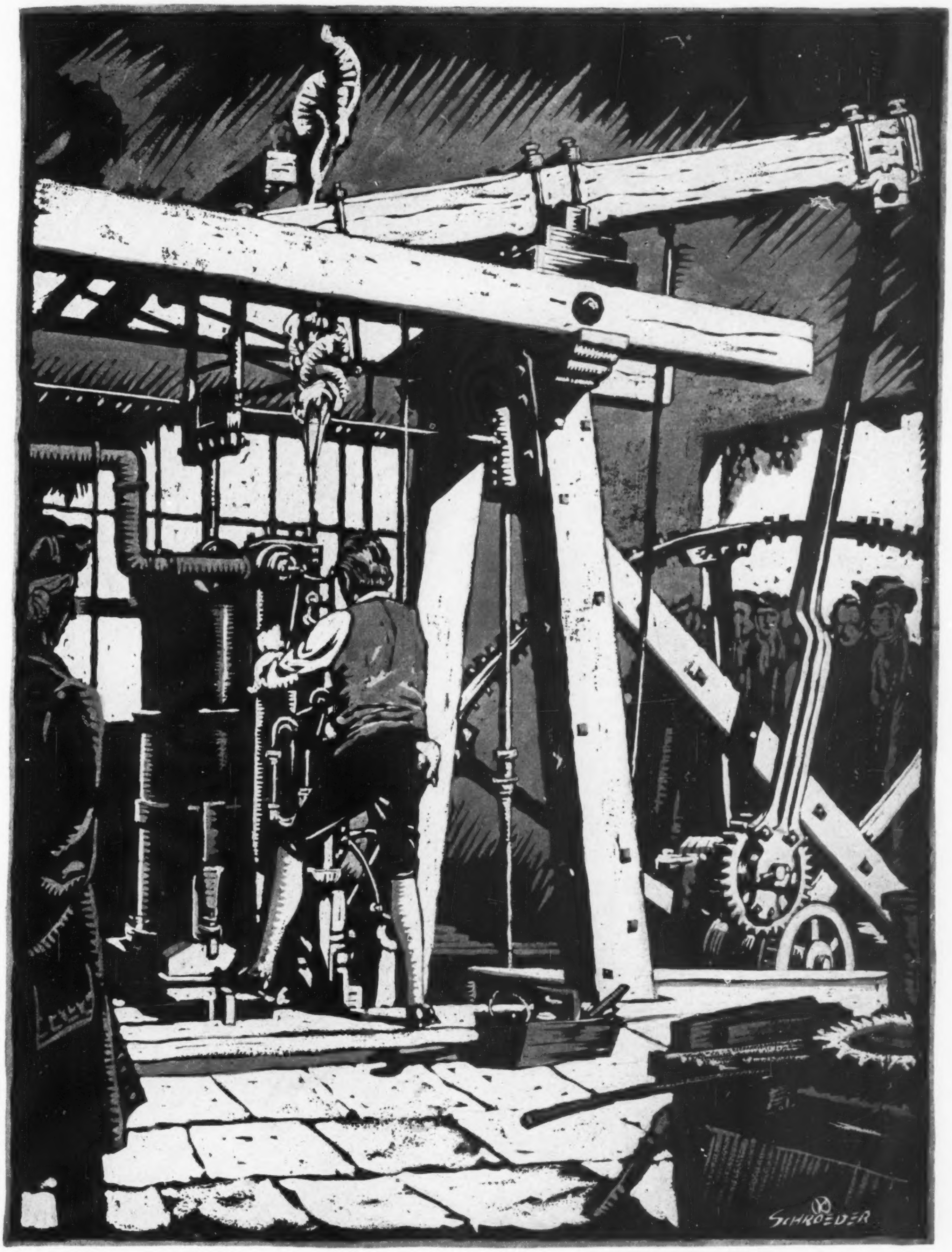

James Watt and His Steam Engine

Great Moments in Machine Design—First of a series of original drawings prepared exclusively for this magazine symbolizing the designer's contributions to the progress of mankind

MACHINE DESIGN

September *1929*

Adjustments in Automatic Machines Test Skill of Designers

By L. E. Jermy

Managing Editor, Machine Design

EVERY designer who has helped to develop a new model of automatic machinery is familiar with the trying and sometimes almost overwhelming obstacles that are encountered during the period when the first machines are on probation and the "bugs" are being eliminated. It is in times like this that the engineering staff is put to the acid test. It must solve difficult design problems under pressure.

A typical illustration of what is involved in the final process of adapting a newly designed machine to unforseen conditions in actual operation is afforded by the experience of a leading manufacturer of packaging machinery in perfecting a bread wrapping machine. Many of the problems encountered find their counterpart in the development of other types of automatic machinery and for that reason the details of this experience doubtless will be of interest to designers outside of the packaging machinery field.

The machine in question was designed to wrap automatically about 55 loaves of bread a minute. Either ordinary wax paper or semi-transparent waxed "glassine" paper may be employed for wrapping. Several machines were made up to an early design and sent into the field for test. It soon developed that conditions varied to such an extent that whereas the machine was suitable for wrapping one or several kinds of loaves it was not adaptable to all the variations in bread in different sections of the country. The result was that the machine was redesigned and the early models recalled by the factory.

It was necessary that the machine be made easily adjustable to accommodate the various sizes of loaves which might be produced in any single bakery. For instance the machine might

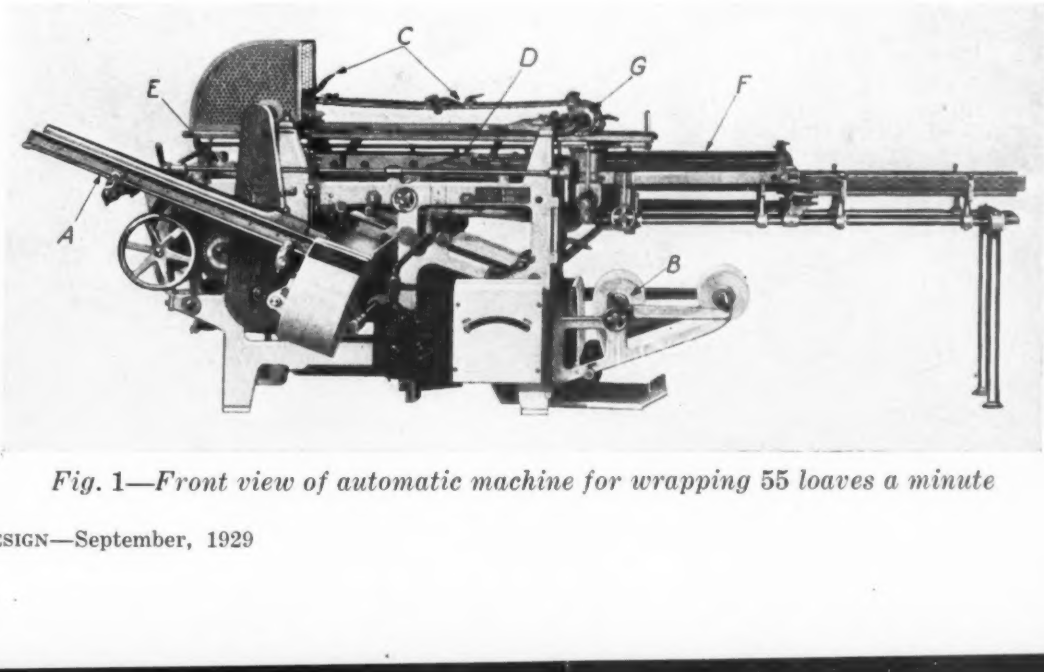

Fig. 1—Front view of automatic machine for wrapping 55 loaves a minute

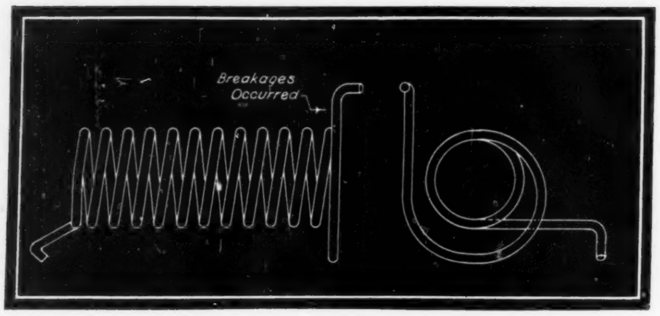

Fig. 2—Original design of transfer arm spring

be called upon to wrap loaves varying from 7 to 13½ inches in length, 2½ to 5¼ inches in height, and from 3 to 7 inches in breadth. Adjustments necessary to take care of this wide divergence of sizes were reduced to five, all of which could be made in about five minutes without interchange of parts. Another important feature of the machine was the paper feed, designed for the use of a minimum amount of paper for each loaf. In this design the loaf itself was allowed to draw its own paper—in other words to draw sufficient paper from the roll to give a complete wrap. The paper was cut off at the completion of the wrapping operation, instead of being cut previously into sheets of predetermined length. The five adjustments and the paper feed will be described in detail later, it being necessary at this point to give a general idea as to the functioning of the various machine mechanisms. This can be indicated best by following the passage of a loaf through the machine, which is shown in Fig. 1.

The loaves are placed by an operator in the feed chute *A*. Each loaf in turn is carried forward by an endless, intermittently moving chain to a position in the machine where the wrapping commences. The loaf is then pressed by a pusher on to a lifter table, taking with it one end of the paper and drawing more paper from the roll *B*. This movement of the loaf automatically wraps the paper around part of the bottom, one side, the top and a portion of each end of the loaf. The raising of the lifter table to a horizontal position wraps the paper around the other side of the loaf while the folding of the ends is continued. The loaf then is pushed forward by transfer arms *C*. The third end fold is made and a knife, adjusted to allow an overlap of about 1½ inches before coming into operation, cuts the paper under the bottom of the loaf. The loose end of paper, guided by a roller fitted across the ends of two swinging arms, then is positioned to take care of the next loaf to be wrapped. The loaf actually being wrapped passes between side folders *D* and the folding is completed.

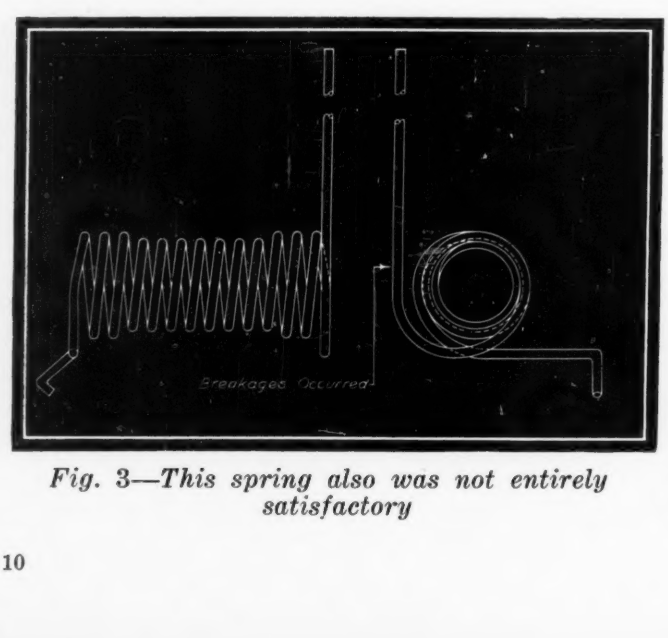

Fig. 3—This spring also was not entirely satisfactory

The bottom lap of paper is heated in passage over a heater plate fitted with spring actuated and heated sealer fingers, and the end folds are heated at the same time by spring operated side heaters. These are sufficiently hot to melt the wax on the paper and the seal is made by passage of the loaf between long cooling belts *F*. At the end of the belts is a delivery table from which an operator takes the loaves for transfer into boxes or cartons.

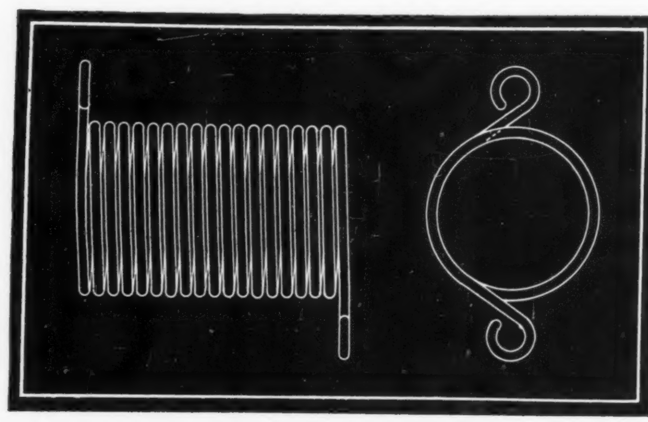

Fig. 4—Successful final design. Two of these springs were used for each set of transfer arms

The five adjustments necessary in changing the machine from one size of loaf to another were: (1) The material feed chute, *A;* (2) feed chain for material; (3) the end tuckers on lifter table *E;* (4) the side folders, with which are included the side heaters *D;* and (5) the cooling belts *F*. These adjustments took care of all variation in length of loaves. Variation in the width and height, within the range were accommodated automatically by the machine.

In designing and developing the paper feed many difficulties arose due to the differences in the paper stock furnished by the paper manufacturers and also to the fact that in hot weather or hot locations the paper often would stick instead of feed-

ing easily from the roll. This was overcome by providing ball bearings for the paper roll shaft; an intermediate, driven paper feed roller and also a gravity roller, operating between vertical guides, under which the paper passed in its travel to the loaves. The action of this roller was such that it would rise when the loaf was drawing paper, and fall when the pull on the paper ceased. Tears and breaks thus were eliminated by decreasing the snatching or jerking action on the paper.

The swinging knife used for cutting the paper was found to work best if provided with saw teeth. A straight knife simply dragged the paper instead of piercing and severing it. To still further eliminate any tendency to drag, the knife was tapered back slightly from the center to each side thus piercing the center of the paper first. Originally this paper knife was stationary, the paper being cut by being drawn across it. In practice, however, the saw teeth became blunt after short service and it was necessary to design a swinging knife operated by a cam on the mainshaft. One of the most serious troubles met with in the cutting of the paper arose from the wrapping of "split" loaves with hard, crusty tops. The points on the crust often would cut the paper at the time the knife operated, due to the pulling of the paper too tightly around the loaf. This was remedied by employing a clamping roller adjacent to the knife. The roller, which was operated by another cam on the mainshaft, clamped the paper prior to the cutting operation thus preventing any tightening of the paper around the loaf.

Variations due to the texture of bread in different localities, or due to hard or soft baking presented considerable difficulty. For instance, a backstop was provided on the lifter table to hold the paper against the loaf and to prevent the loaf from being pushed so far that too much paper was drawn from the roll. A hard loaf would operate this backstop perfectly; a soft loaf however, would squeeze together or even break due to pressure of the stop. A backstop slide with gibs and springs then was designed for delicate adjustment. Prior to the adoption of this design several breakages had occurred, the same part being involved in each case on different machines. This part was one of the bearings of the transfer mechanism, shown at *G*, Fig. 1. Obviously if a loaf became crushed and did not feed forward in sequence, the next loaf would pile on it and a jam occur which was in some cases serious enough to break the transfer bracket. The solution of this was found in the fitting of a safety clutch on the drive shaft. The clutch was the usual three-pin type, the

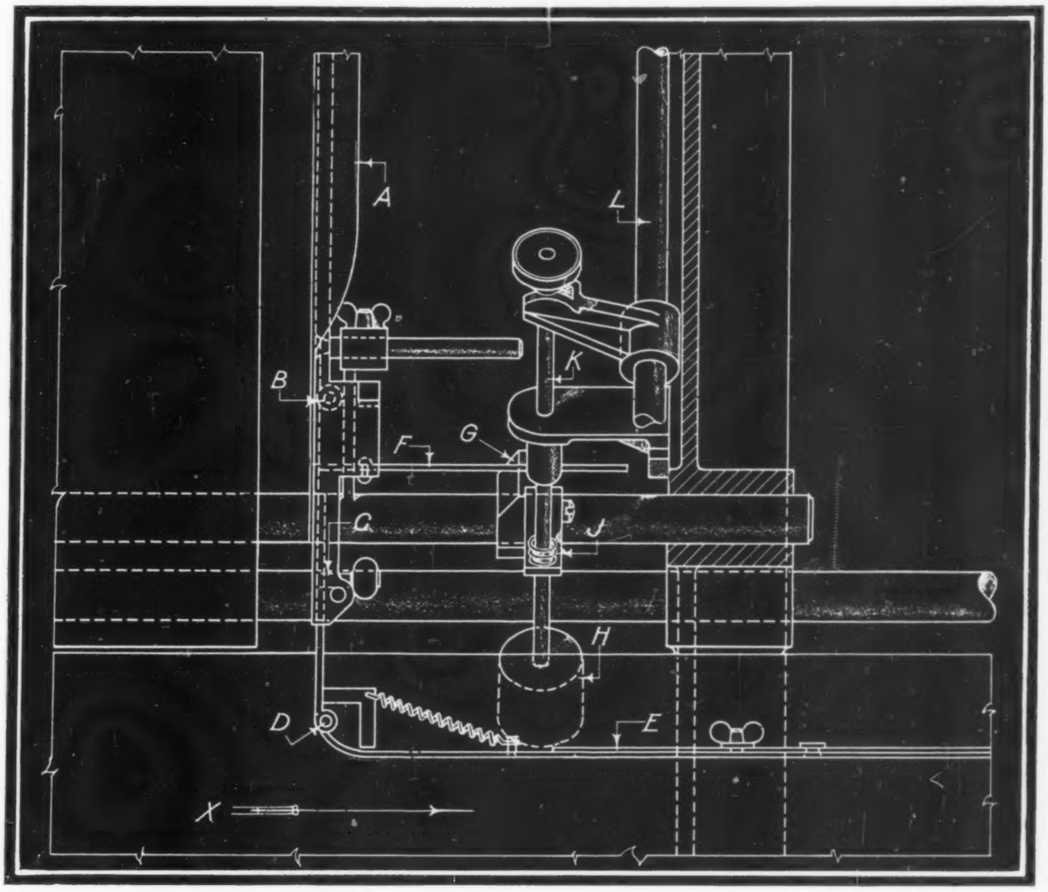

Fig. 5—Safety stop for loaves. Loaf travels in direction X; if twisted it hits the stop at D. This moves release bar F away from shoulder on vertical drop rod K. Drop rod falls, pulls down bracket on control bar L and machine stops.

A—Chute Side
B—Safety Stop Hinge
C—Adjustment Clamp
D—Side Guide Hinge
E—Side Guide Extension
F—Release Bar
G—Release Bar Rest
H—Drop Weight
J—Spring Bumper
K—Vertical Drop Rod Bar
L—Machine Control

pins having tapered ends to operate in a drive plate and being actuated by adjustable spring pressure.

This clutch served many useful purposes, not only stopping the machine dead when a jamming of loaves occurred, but also coming into action

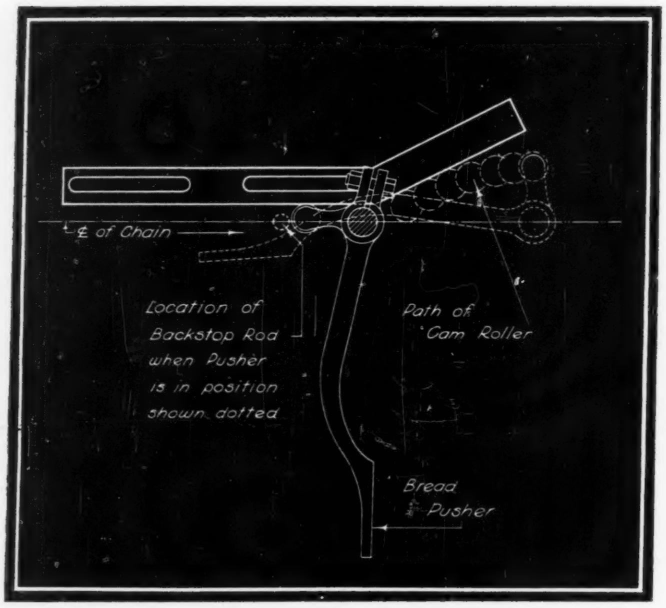

Fig. 6—Early design of cam permitted noise due striking of transfer arms against backstop

at any time an undue strain was put on the working mechanisms of the machine. An incorrectly made adjustment causing fouling of parts, any foreign object carelessly dropped into the machine during operation, the trapping of an operator's clothing or other accident would immediately throw out the clutch.

The layout of the cam for operating the lifter table required considerable thought. The arms supporting the table, were pivoted at one end, and the other end of the table was raised and lowered by lever action from the cam. This rapid raising and lowering of the comparatively heavy table, with rest positions at the top and bottom of the stroke caused stresses in the mechanism which it was necessary to reduce by developing the cam form to permit as gradual an approach to the rest periods as time would allow. The arms of the table were aluminum castings and the lifter plate onto which the loaves were pushed was also made from aluminum.

In the design of the side folders, *D*, Fig. 1, it was necessary to provide flexibility to accommodate variations in the length of loaves from the same batch. This was accomplished by the use of coiled springs on the folder plate pins, the pins passing through clearance holes in the carrier arms; the folders thus were allowed to accommodate themselves to unusually long loaves.

Heating Paper Presents Problem

Certain types of loaf are made with overhanging ends and the wrapping of these was more difficult than the wrapping of the loaf of uniform shape, particularly in respect to the sealing of the paper. The side heaters originally were made from brass castings, a single heater about 4½ inches high being employed at each side. However, these heaters had little flexibility and when loaves with overhanging ends passed through, only the extreme ends would make contact. Thus if the folds of the paper did not reach as high as the overhanging ends the folds would not make contact with the plate and seal by the melting of the wax. It therefore was essential that each plate be replaced by two plates (top and bottom) at each side. The plates were about 2 inches high with a ¼-inch space between the top and bottom plate. These plates were hung on and held by flat springs and were pivoted at each end, the pivots passing through slots in the plate brackets. Consequently each plate was sufficiently flexible to have movement both in and out and also to turn on an angle if necessary. This allowed the heater plates to conform to the shapes of the loaves with overhanging ends, and also to badly formed or tapered ends of other loaves.

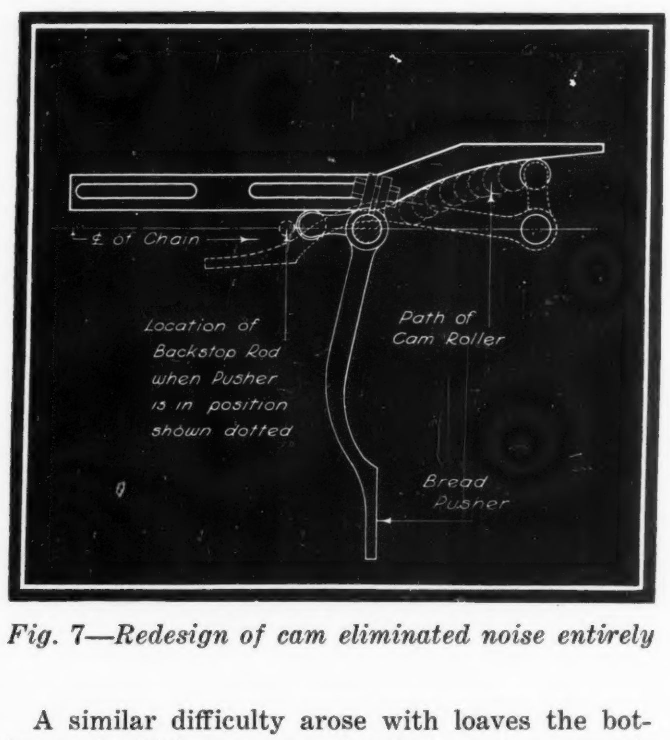

Fig. 7—Redesign of cam eliminated noise entirely

A similar difficulty arose with loaves the bottoms of which were not flat but concave curved. This curve prevented the heating of the lap of the paper and to overcome this a row of spring operated and heated sealer fingers was fitted at the end of the heater plate. A second row of

sealer fingers, not heated, was fitted about 6 inches beyond for cooling purposes. These fingers projected about ½-inch above the plate in their maximum high position, and by hinge action would depress to the plate height when necessary. Thus the fingers followed the contour of the bottom of the loaf when it passed over them, with resulting satisfactory heating of the paper lap.

Eliminating Spring Failures

The transfer mechanism consisted essentially of a pair of endless chains, five pairs of transfer arms and the end shafts and brackets. Each pair of arms was suspended from a sleeve assembled to a cross shaft between the chains. These arms were raised and lowered by hinge action of the sleeve, their movement being governed by cam pieces and torsion springs. At first the springs gave endless trouble due to breakage, the continuous twisting action causing the spring to snap at the end where it was necessarily bent to fit into a locating hole in the shaft bracket, as indicated in Fig. 2. The breakages were sufficiently frequent to cause redesign of the spring and the change of the locating point at the weak end. The bend in the spring was eliminated and an end about 6 inches long left on at the last coil, as shown in Fig. 3. This end then was sprung under the back stop-rod of the transfer arms. Even with this change breakages were not entirely eliminated and the use of two springs (Fig. 4) for each transfer arm shaft was found desirable, this allowing for a reduction in the diameter of the wire.

Safety Stop Prevents Jamming

In feeding the loaves down the feed chute it was no easy task for an inexperienced operator to keep the machine wrapping constantly. Consequently, due to carelessness sometimes caused by haste or reason of the chute becoming practically empty, one of the loaves might become twisted at the bottom of the chute. If this did not straighten out but continued on an angle into the machine a jam inevitably occurred and the loaf was spoiled by crushing. This often led to trouble and expense, being liable to happen many times during the wrapping of a single batch of about 10,000 loaves. A safety stop, Fig. 5, was designed. This consisted essentially of a hinged continuation of the side of the feed chute, a drop rod and its support and a knock-off lever attached to the starting and stopping mechanism. The misplaced loaf, in feeding forward, would strike the hinged plate which when moved allowed the drop rod to fall and stop the machine. In practically all cases the loaf was not damaged, but could be wrapped after being straightened out by hand.

Early designs of the machine were somewhat noisy on account of the layout of the cams operating two of the units One of these was the transfer arm unit. As mentioned previously, the transfer arms were raised by cam action for the purpose of leaving each loaf in turn in the heating mechanism long enough to melt the wax for sealing. The noise was caused by the transfer arms rising rapidly and striking the backstop rod, Fig. 6. The cam, Fig. 7, is a redesign to allow faster initial rising of the arms, the speed being gradually reduced as they neared the back stop. Thus the noise was eliminated, the arms being practically at rest when the backstop was reached. The other noise mentioned was caused by the striking of a cam roller on the face of the cam for operating a pair of re-

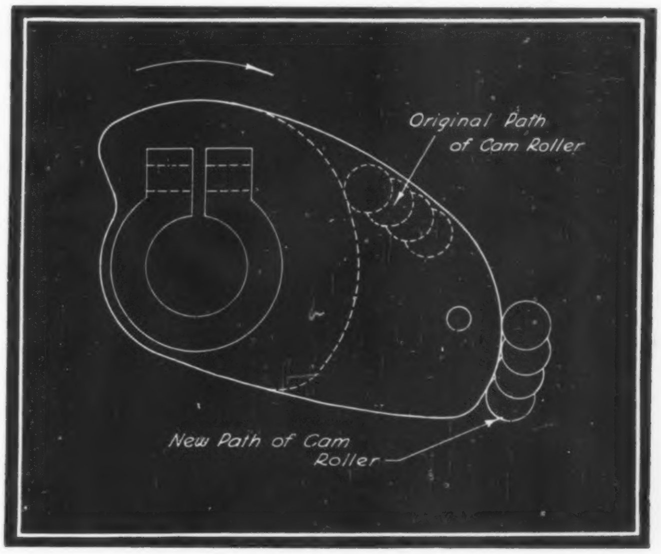

Fig. 8—Cam for operating retainer fingers. Original cam shown dotted

tainer fingers which held the loaf on the lifter table. These fingers were lowered by the action of the cam and lever when the loaf was about to be pushed off the table. Due to the location of the cam being beneath the rising and falling lifter table it was impossible for the cam layout to be such that the cam roller followed it around the whole 360 degrees. In the redesign, Fig. 8, the layout was changed to allow the cam roller to come into contact with the cam at the rest position at the top of the table stroke. This eliminated the noise entirely.

The many troubles and difficulties encountered and overcome successfully in the design of this wrapping machine serve to indicate that however well a machine may be designed initially, many factors operate to necessitate later changes. That eventually these difficulties are ironed out satisfactorily is a tribute to the skill and perseverance of the designers of automatic machinery.

When Should Welding Be Employed in Machine Design?

By Robert E. Kinkead
Consulting Engineer, Cleveland

DESIGNING machinery would be child's play if the designer could only build a new plant before the job had to go into production. In real life, we usually have to design a machine which can be built in a plant in which a considerable part of the equipment is obsolete, and which is under the direction of a management influenced by a great many factors not related to scientific machine design. The final design, therefore, represents an approximation of what the designer thinks will be acceptable to his employer or the client rather than an original and unique application of scientific principles. The everlasting hope that he will some day get a free hand to design a machine without such practical restrictions keeps the machine designer from going crazy—perhaps.

The case of a large press manufacturing institution illustrates an interesting phase of the problem of applying a fairly new idea to the design of power presses—the use of welded steel construction in place of gray iron castings. The chief engineer wanted to use welded steel in place of castings. He called in a consultant to find out the implications of such practice. It developed that more than half the tangible assets of the company consisted of a gray iron foundry. The foundry would have to be shut down, and approximately $500,000 of new capital put into the business to provide a steel working plant. The proposed plan would have meant writing about $200,000 off the capital account. Knowing the financial condition of the company (and not knowing precisely where he could find another $10,000 a year job) the chief engineer wisely dropped the subject of welded steel construction.

It would be quite impossible to cover in this article, or in a large volume for that matter, all of the practical considerations which affect the application of the new developments in welding to machine design. We can, however, establish the theoretical basis upon which most of such uses of welding are made.

The public has accepted welding. From a General Electric refrigerator to a Bellanca airplane, from welded water, gas, or oil lines to welded steel bridges and buildings, the public sentiment

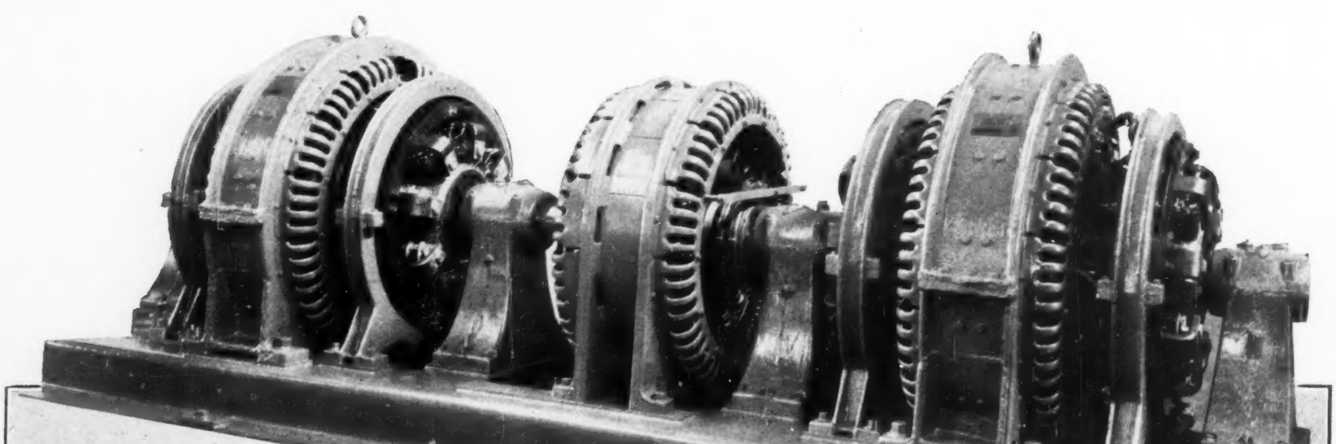

Fig. 1—12,000-ampere chromium plating set mounted on welded steel plate base

on welding has been explored. Therefore the use of welding in place of other manufacturing methods is a matter of business economics (with the exceptions noted above). If a machine can be built at less cost by the use of welding methods, and equally good or better results obtained from its operation, welding ought to be

Fig. 2—Heavy internal combustion engine parts made under process control. Metallurgical and engineering work on design has reduced cost of using steel castings

employed. This leads to the question: "Where can welding be used in machine design, and how much will it cost?"

Since we have already mentioned welded steel in place of gray iron castings, we will start there.

The physical properties of hot rolled steel and of gray iron are well known. From the theoretical point of view, the question is largely one of whether or not an assembly of pieces of hot rolled steel can be welded together to serve as a machine part for less cost than the piece can be made in gray iron. If the machine part under consideration is at all complicated or intricate, or weighs less than 50 pounds, the chances are better than even that the casting will cost less than the proposed welded steel assembly. On the other hand such large machine parts as bases and frames frequently may be made of welded steel at 20 to 40 per cent less cost.

Costs Should Be Considered

The cost of welded steel assemblies is largely a matter of preparing the individual parts for welding, that is, cutting to the proper size and forming to the desired shape. The actual welding cost is usually small as compared with these items. However, the actual welding merits careful attention on the general theory that it would be unsafe to send out a welded assembly unless a satisfying answer can be given to the question: "But how do we know it is a good weld?" Welding done under adequate procedure control and inspection is perfectly safe. Welding done otherwise may prove very expensive.

Welding enthusiasts have made many comparisons in connection with the relative tensile strength of cast iron and hot rolled steel and have drawn the conclusion in many cases that enormous weight reductions could be made in welded steel assemblies because of the far greater tensile strength of steel. However, from the machine designer's point of view the matter is not so simple. The strength and rigidity of a machine part is dependent on the physical properties of the metal used, and in most cases is dependent to a greater degree on the shape of the piece.

Where it is possible to use pressed steel, as in the case of automobile rear axle housings, the welded steel assembly may weigh only a fraction as much as an equivalent casting. The same is true of gear cases, true cylindrical shapes, columns, beam sections, etc. But machine parts frequently involve complications of most irregular shapes. Where such complications cannot be avoided, the employment of structural steel sec-

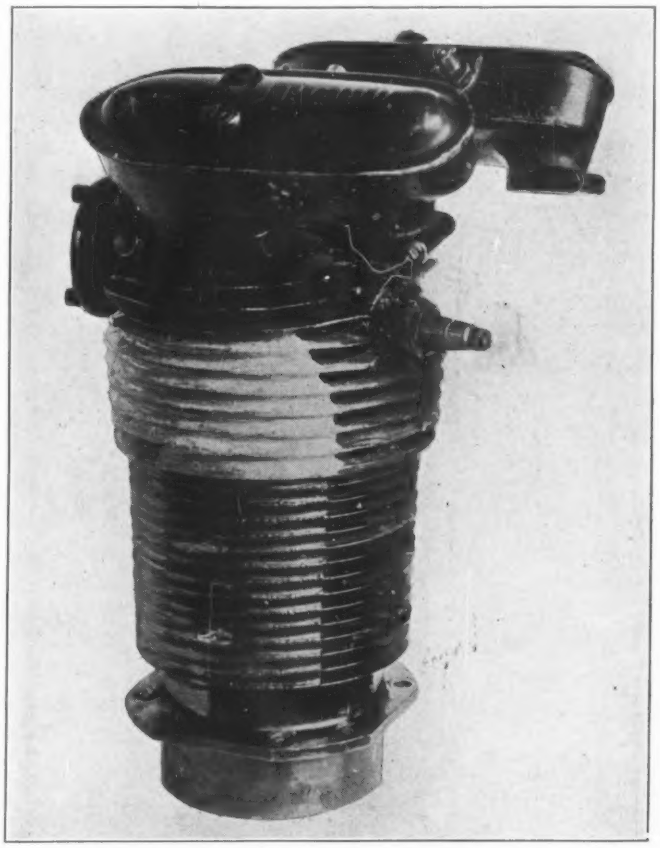

Fig. 3—Welded shrouding on airplane cylinder permits uniform cooling by carrying cool air from forward side to rear through shrouded fins

tions and flat plate involves the use of much heavier cross sections of steel due to the fact that the most economical shape cannot be reproduced from standard sections. Where plate and structural sections are used to reproduce com-

plicated castings, the weight ratio is usually more of the order of steel one to cast iron two, rather than one to five as might be expected from the tensile strength ratio of steel to cast iron.

The shape factor in the design of machine parts is of such importance as to lead to an inquiry into the possibility of using steel castings profitably where the initial investment required to get the desired shapes by the use of hydraulic presses is too high. Such inquiry may lead to advantageous results for the machine designer. In fact, it may confidently be asserted that a general investigation of the possibilities of welded steel construction is incomplete without an adequate analysis of what can be done by a modern steel foundry. Steel castings can be welded together as readily as hot rolled steel parts. It should be recognized in this connection that a modern steel foundry organization is a different institution than the steel foundry of fifteen or even ten years ago. Metallurgists and design experts have been added to the steel foundry staff, and in many cases steel castings cost about half as much to use as they did five years ago. The price per pound may be the same but the certainty of perfect castings has increased to the point at which, in some parts, only half as much steel is required. The use of alloys has resulted in important contributions in the same direction. Nor is the story of the modern steel foundry complete without reference to the adoption of modern welding practice in the cleaning room.

Welding Uncertainties Eliminated

In the lower carbon steels, welds are being made in the steel foundry which are as strong and as ductile as the original metal of the casting. The welds are made under identically the same procedure control that is used in high pressure tanks, pipe lines, etc. The uncertainty due to the human factor has been completely eliminated. The result is that a welded casting is no longer a "patched up job" in a modern foundry. It can actually be insured against failure in the same way as tanks and pressure vessels are insured.

The significance to the machine designer of these welding developments in the steel foundry is that he can use steel castings profitably in many cases where the capital outlay for cold pressed or hot formed steel would be too high. He can specify that the foundry shall weld together a group of simple steel castings into an extremely complicated assembly and be assured that the welded assembly will be perfectly reliable. In some cases welded assemblies cost considerably less than the complicated part made all in one casting. Nor is there any restriction on the designer's use of an assembly of hot rolled steel and steel castings welded together if economies result.

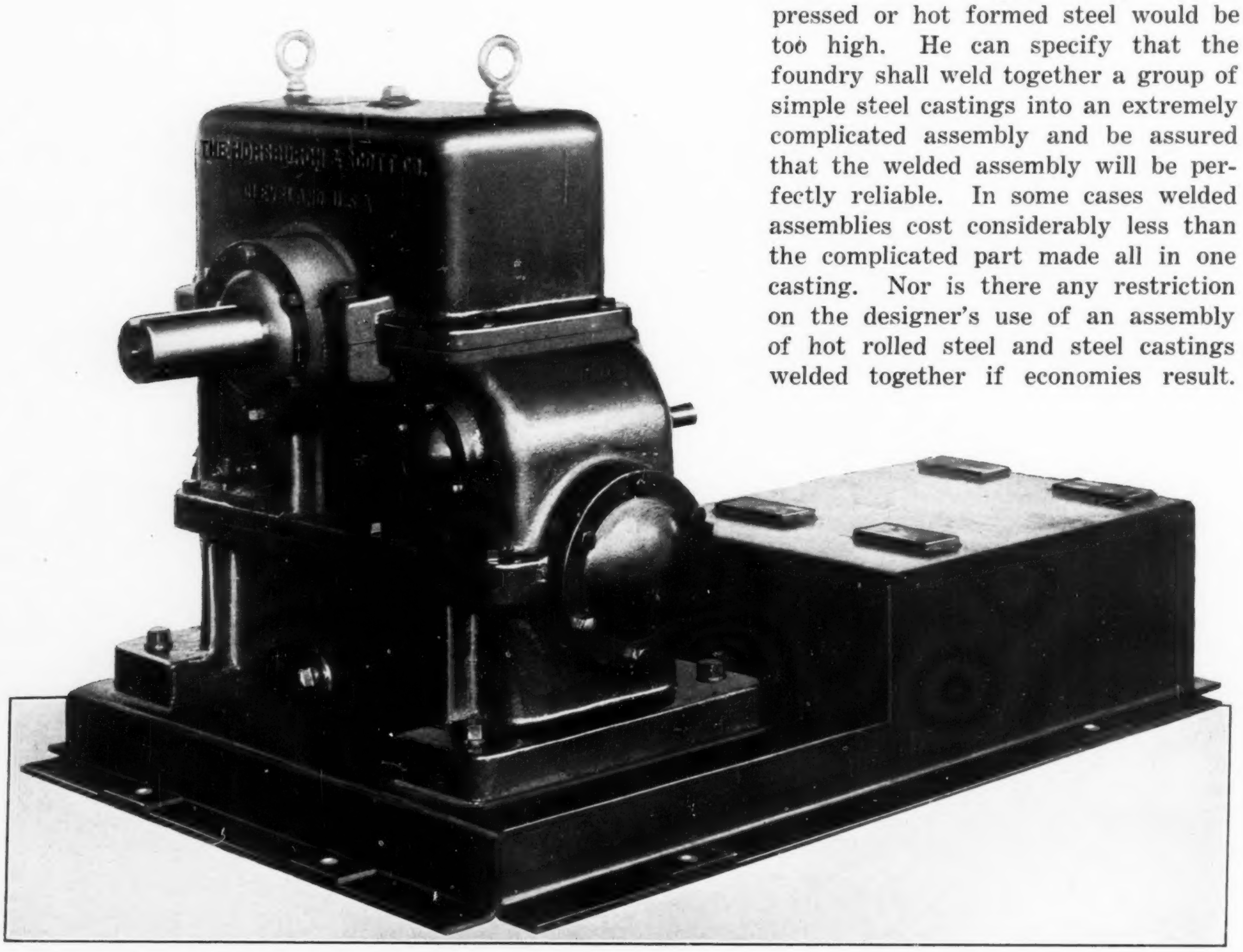

Fig. 4—Welded steel plate base for worm and gear speed reducer. Gray iron castings prove more economical than welded steel for gear case

It should be evident from the general outline given that a decision to use welded steel construction is seldom a simple clean cut proposition but involves a careful analysis of the alternatives offered by modern steel foundry practice.

In some cases quite unexpected results are obtained by welded steel designs which offer striking advantages from the machine user's point of view. The case of welded steel plate bases as shown in Figs. 1 and 4 is a good example of the surprise results which are often obtained.

Design Machine Bases for Strength

It is customary to mount such equipment as motor-generator sets, centrifugal pumps, worm and gear speed reducers, etc. on some kind of a metal base. The equipment on its base is then supposed to be mounted on a concrete foundation. Actually, the user mounts it on a concrete foundation if he gets around to it but in many cases merely sets the equipment on the floor, bolts it down and lets it go at that.

In view of the high speed of such equipment, the uncertainty of the foundation arrangements, and the probability that the "biggest man with the biggest wrench" will tighten down the foundation bolts, the design problem has been rather difficult. A study of existing machine bases in this class disclosed the fact that designers had been making these bases in gray iron with such beam and torsional strength as to give "reasonable" resistance to the efforts of the "biggest man with the biggest wrench" to distort the base sufficiently to destroy the alignment of the machines mounted on it. But it appeared certain that so long as the erectors could not be relied on to exert "reasonable" pressures on the foundation bolt nuts, a certain amount of base distortion would occur with resultant vibration and bearing trouble. In developing the welded steel base it was decided to make a base the erector could not distort.

The accompanying illustrations show the welded plate type of base. The main part of the base is made of one piece of steel plate formed on a bending brake. Bases made of structural I-beams and channels did not prove acceptable to the users. Foundation bolt holes are placed in the bottom flange. Stiffener ribs are welded to the under side of the base. It will be observed that the worst that can happen if the erector sets up the nuts on the foundation bolts too tightly on a foundation which is not level is that the flange will be distorted. The main beam section of the base will not be affected. The fact that the material of the base is steel and relatively flexible permits this type of construction which is practically fool proof so far as the erectors are concerned. The base cannot be broken or seriously distorted except by deliberate intent. In passing, it may be stated that welded ribbing on the under side of the base eliminates all vibration or "rumble" of the base due to operation of high speed equipment on it.

This point is further illustrated by the airplane cylinder shown in Fig. 3. The cylinder is a usual air-cooled type but has welded shrouding on the sides. The purpose of this welded shrouding is to entrap the cool air on the forward side of the cylinder and carry it to the rear of the cylinder so that the cylinder will be cooled equally on both windward and leeward sides. This is desirable in order to prevent warping of the cylinder and unequal wear on the piston. Use of welding to apply the shrouding makes the shrouding a part of the cooling surface of the cylinder, due to the perfect thermal conductivity of the weld.

The significance of present day welding practice to machine designers may perhaps be generalized under the following classifications:

1. Permits the use of welded assemblies of hot rolled or cold pressed steel details. The object of such practice is merely to effect cost reductions.
2. Increases the certainty of uniform quality in steel castings where the foundry does the welding under procedure control. Permits welded assemblies of a group of steel castings, or steel castings and hot rolled steel details. Reduces net cost of using steel castings.
3. Permits the accomplishment of entirely new results by the use of designs which were impractical prior to the development of welding practice.

Nominate A. S. M. E. Officers for Next Year

At its recent meeting in Chicago, the nominating committee of the American Society of Mechanical Engineers chose the following names to go on the ballot for the election in September of officers for 1930:

For president, Charles Piez, chairman of the board, Link-Belt Co., Chicago; for vice presidents, Paul Doty, advisory engineer, St. Paul; Ralph E. Flanders, general manager, Jones & Lamson Machine Co., Springfield, Vt.; Ernest L. Jahncke, assistant secretary of the navy, Washington, and Conrad N. Lauer, president, Philadelphia Gas Works Co., Philadelphia; for managers, Harold V. Coes, industrial engineer, Ford Bacon & Davis, New York; James D. Cunningham, president, Republic Flow Meters Co., Chicago and Clarence F. Hirshfeld, chief of research department, Detroit Edison Co., Detroit.

Photo Cell in Sorting Machine Excels Human Eye

By Lester Ferenci

MORE and more is electricity becoming a vital factor in machine design. Until a few years ago, when a machine was required for the performance of one or more manufacturing operations or for the inspection of a product, the designer was confined to a comparatively clearly outlined method of precedure. He was expected to requisition a certain number of gears, cams, sprockets and chains, eccentrics and genevas from the profession's stock of orthodox mechanical movements and, with more or less ingenuity, assemble them into the required mechanism.

Today we find that much tricky mechanism can be eliminated by the use of simple electrical devices which lately have been standardized. The use of various types of electric motors is no longer considered novel. We are beginning to realize the advantages to be gained by the use of electrical equipment in machinery and for this reason machine designers rapidly are familiarizing themselves with the functions of various electrical units, their principles and their possible utility in mechanics. Many of our modern machines employ reversing motors, torque motors, intermittent cycle motors, inspection and relay switches and solenoids. Mechanical equipment can be substituted to do somewhat the same work in certain cases but in others we find ourselves entirely dependent upon electricity. One of the most striking examples of the utilization of this trend in modern machine design is shown in a commercial machine lately introduced into the tobacco industry. This is a cigar shade-sorting machine which will sort automatically 4000 cigars per hour. It is built around a photo electric cell or "electric eye" which automatically "looks" at each cigar fed through it, determines its shades used in commercial classification, and causes it to be placed in its proper shade compartment on the machine. The sorting machine can select and sort shades with far greater precision than is possible with the human eye.

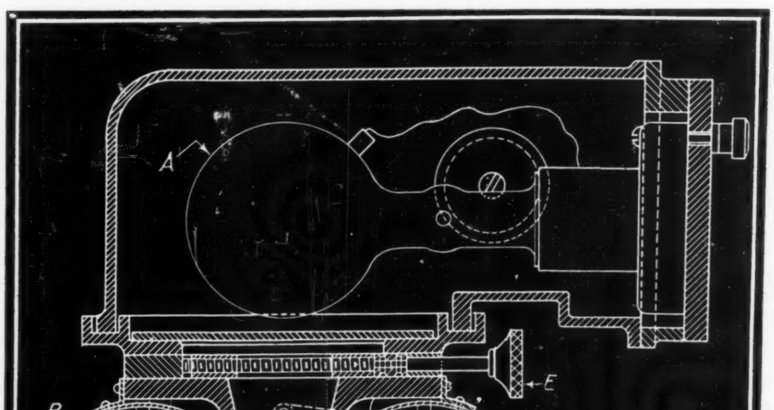

Fig. 1—Details of photo cell mechanism which controls the sorting of cigars into ten different shades

The electric eye is used extensively in the transmission of pictures by telephone, in radio movies, etc.; its characteristics being that is passes a current of electricity proportioned to the light falling on it. The theory worked on for the cigar sorting machine was that there is a band or bands in the spectrum in which each cigar reflects maximum light. This was arrived at by taking an electric eye and correcting it with a filter in conjunction with a source of illumination so that a balance of sensitivity over the

whole used spectrum range was secured. By placing various band pass filters covering the used part of the spectrum in sequence between the cigar and the electric eye, and taking a reading under each one, it was found that the highest reading determined the color group and the sum or mean of all the readings determined the shade in the color group. Therefore, if a given area of cigar be exposed to light at a constant distance, from a constant source of light, the light reflected by the cigar will be proportional to the brightness or shade of the cigar; a light cigar reflects more light than a darker one. An electric eye placed in the path of the reflected light will pass a current proportional to the brightness or shade of the cigar. The current intensity is then amplified by vacuum tubes similar to those used in radio and measured by a milliameter with a contact making device closing a different set of contacts for each position of the milliameter needle. These contacts set trippers which deposit the cigars in separate bins.

In this machine the constant area of exposed cigar at a constant distance is obtained by pressing the cigar against a mask with an opening which leaves the same area exposed, at the same place for all cigars. If for any reason the cigars were not properly pressed against the exposure mask, admitting light in addition to that provided by the two 40 watt lamps contained in the cell housing, improper sorting would result.

Mechanical operation of the machine is comparatively simple. The cigars are fed from a hopper and delivered into pockets mounted on an intermittently driven conveyor chain. The chain passes under the electric eye housing and while the chain is at rest the exposure mask of the housing is moved down and pressed lightly against the cigar. Each pocket has a movable dog mounted under it which is released by an electromagnetic shuttle in one of ten fixed positions corresponding to the contact over which the needle of the milliameter comes to rest. The function of these dogs is to open the retaining fingers holding the cigars in the chain pockets. There are eleven bins on the under-side of the conveyor chain. Each of ten of the bins has a trip pin so positioned that it coincides with one of the ten positions in which the movable dog can be released. When a dog comes in contact with any one of the ten trip pins, the pocket fingers are opened and the cigar is permitted to drop into its proper bin. The eleventh bin receives all cigars not of the required commercial shade range.

The machine, completely assembled ready for operation, is shown in Fig. 2. The cigar hopper is at the left hand end of the machine. At the right we have the amplifying unit on top, under which the housing of the electric eye is visible. The small rectangular enclosing case at the right houses the milliameter or selector switch. The position of the chain pockets and bins is clearly shown in the illustration.

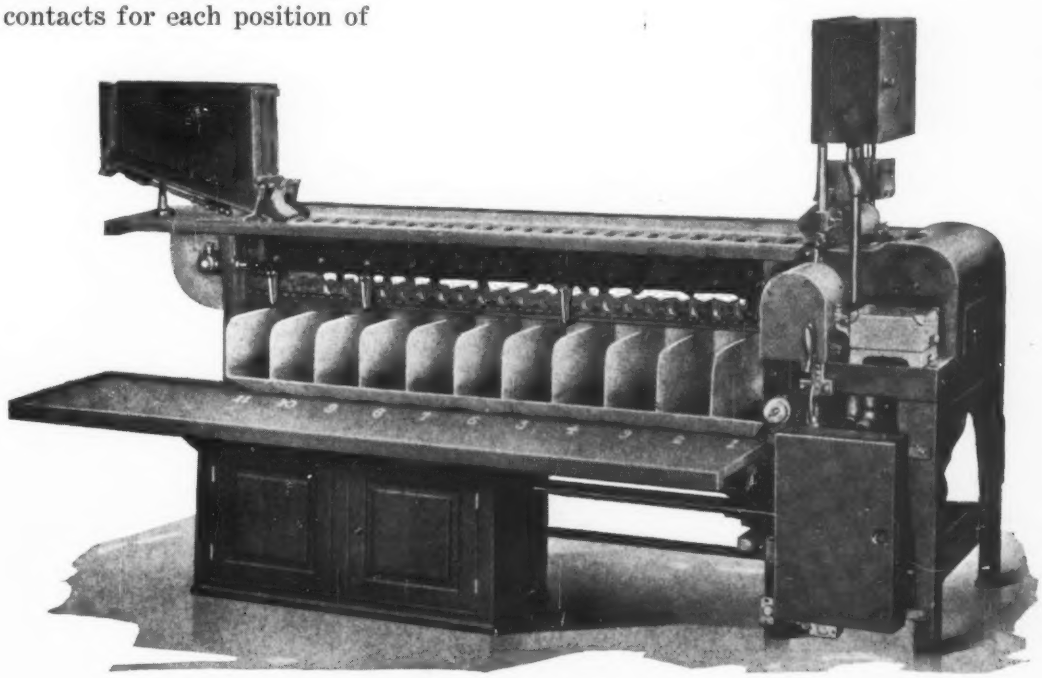

Fig. 2—Front view of cigar sorting machine showing conveyor chain, chain pockets, sorting bins and other details

The line drawing, Fig. 1, is a section taken through the cell housing showing its arrangement. The mask F is shown in position over the cigar C. Light from the lamps B is reflected by the cigar through the shutter unit D to the cell A. The knurled adjusting screw E controls the quantity of light permitted to pass through the shutters and is used to govern the sensitivity and shade range of the unit.

Hypoid Gearing Affords Interesting Possibilities in Design

MACHINE designers sometimes are confronted with the problem of using bevel gearing in places where one shaft must cross another. Such a design of course necessitates offset gears, an example of which is shown in Fig. 1, wherein two hypoid pinions are mounted on a continuous driving shaft. The idea is not a new one by any means and when such gears were provided with straight, oblique teeth they were termed skew bevel gears. Illustrations of such gears can be found in old text books.

With the remarkable progress made in machine design during the past 20 years have come new and improved methods of gearing, including the accurate generation of gears to run on offset axes. These developments are touched upon in a paper, "Large Spiral Bevel and Hypoid Gears," by Allan H. Candee, mechanical engineer, Gleason Works, Rochester, N. Y., presented at a recent meeting of the American Society of Mechanical Engineers at Rochester.

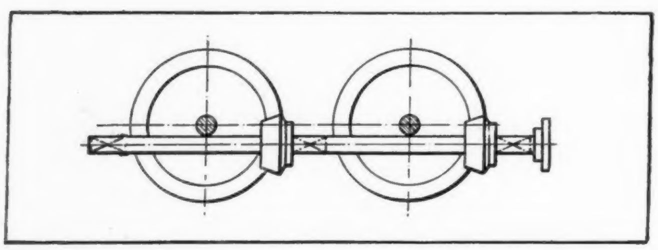

Fig. 1—An interesting design possibility is shown in these two hypoid pinions mounted on a continuous driving shaft

Mr. Candee shows that as a result of recently improved methods, it is possible to cut gears for any condition, that is with axes either intersecting or nonintersecting. Such gears may be classified into three main groups or types as follows:

Type of gear	Relation of axes	Pitch surfaces
Bevel	Intersecting	Cones
Spur	Parallel	Cylinders
Hypoid	Offset	Hyperboloids and other forms

The underlying geometrical forms of these three types of gears are illustrated in Fig. 2 wherein the form at the left are bevel gears with intersecting axes and pitch cones; those in the center are spur gears with parallel axes and pitch cylinders; and those at the right are hypoid gears with offset axes and pitch hyperboloids.

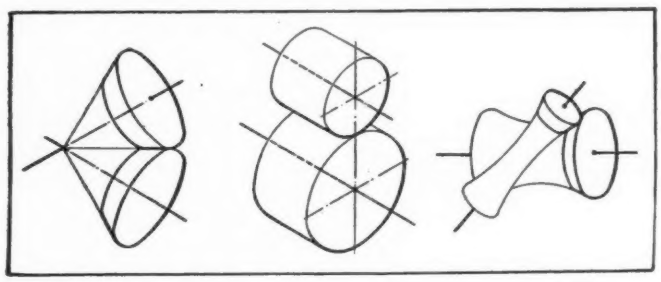

Fig. 2—General types of gears include bevel gears, spur gears, and hypoid gears

The unsymmetrical position existing due to the offset of a hypoid pinion is shown clearly in Fig. 3. At the left of the illustration the solid lines show a pinion inclined away from the central position. The idea is that the hypoid pinion apex O_1 can be swung to either side of the gear center line. The pinion indicated by the dotted outline with its apex at the center, O, of the gear is a bevel pinion. It is quite conceivable that both sorts of pinions might mesh with the same gear.

At the right of the illustration, a single pinion

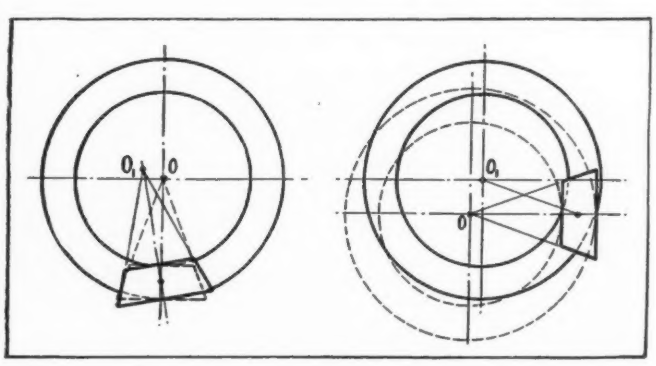

Fig. 3—Diagrammatic illustration of the relative positions in hypoid gearing

is shown meshing both with a hypoid gear in full lines, with center at O_1, and with a bevel gear in dotted lines, with the center at the pinion apex, O. In other words, assuming the position of the pinion to be given, there is entire freedom of choice as to the location of the center of a gear to mesh with it. One of the details in the calculations for designing a hypoid pinion is to determine the required position for the center of the crown gear represented by the machine on which the gear is to be cut, in order that the pinion may be generated correctly to run with its mate.

In a pair of bevel gears, the pitch angles are determined entirely by the ratio of the numbers of teeth, and the spiral angle and radius of curvature can be changed at will. That is, with gear blanks of given dimensions any desired spiral angle and tooth curvature can be cut. In the calculations for hypoid gears they are treated as if they were conical in form, the same as bevel gears; but there is an important difference from bevel gears in that the pitch angles must be determined with reference not only to the ratio but also to the spiral angle and radius of curvature. Otherwise the spiral curves in the pinion would differ too much on the two sides of the teeth and undesirable conditions would occur, such as the teeth being thicker at the inner ends than at the outer ends. For this reason the blank dimensions for hypoid gears have to be worked out to suit the particular spiral angle selected and radius of curvature used.

It is somewhat surprising to find that there are six different combinations possible between the direction of offset and direction of teeth in hypoid gears. These are diagrammed in Fig. 4. The arrangements designated 1A and 1B are standard for automobile drives, because the relative amounts of spiral angle in gear and pinion are such as to make the hypoid pinion somewhat larger in diameter than the corresponding bevel pinion. In general, the direction chosen for the teeth is determined by the required directions of offset, rotation, and pinion thrust.

Hypoid gears possess all the good features of spiral bevel gears and have in addition other advantages due to the offset. Being an intermediate type, hypoids combine with the smooth rolling action of spiral bevel gears some of the smooth sliding action of worms. The amount of endwise sliding between the teeth introduced by the offset, in designs so far used, is only about one-quarter of the amount which occurs in a worm drive with a 45-degree helix angle. This additional sliding action in hypoid teeth is not enough to have any appreciable effect on wear. It is practice in ordinary designs to consider hypoid gears and spiral bevel gears equal in load-carrying capacity. Extensive experience with the smaller hypoid gears on the rear axles of automobiles, however, has shown that the additional sliding action has the beneficial effect of smoothing down the comparative surface roughness of gears when first put into service so that they improve after running. This does not occur in spiral bevels, because at the pitch lines, where

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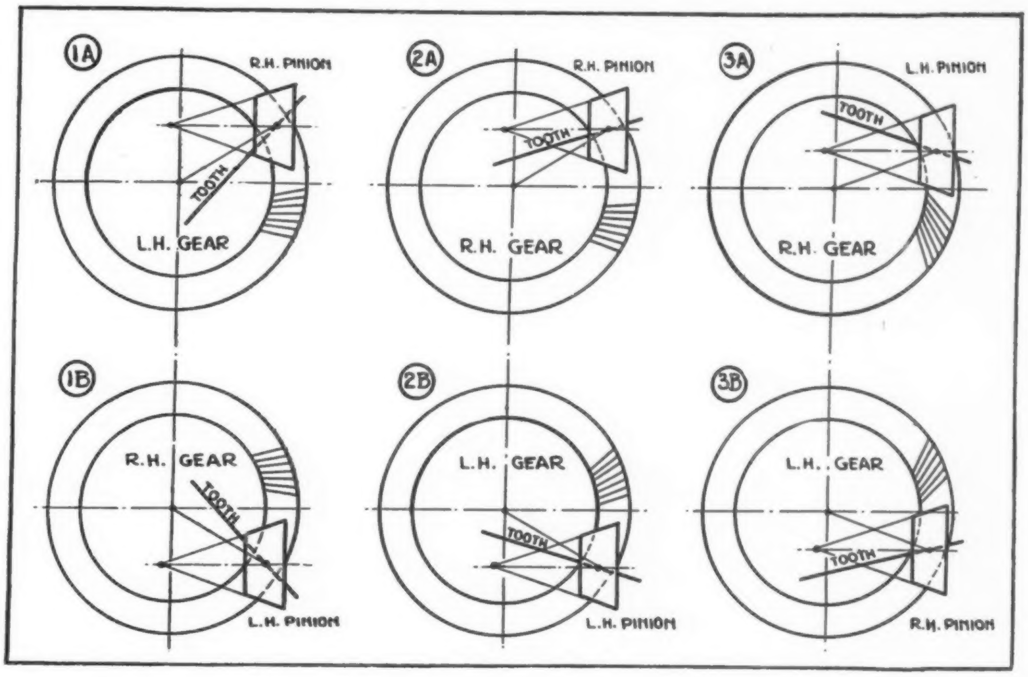


Fig. 4—Hypoid gear arrangements showing six different combinations of direction of offset and hand of spiral

Organization and Supervision of Design Department

By John F. Hardecker

Part I

Design Executives—Subdivisions of Department—New Men—Location and Equipment—Personal Equipment

JUST as in earlier days the basis of design was believed to lie in an intimate knowledge of what had gone before, so was organization of the design department established along purely traditional lines. Just as empirical knowledge since has given way to real mechanical engineering precepts, so too has scientific organization been revealed as a definite means to an end—the end being consistently good design.

There is not, nor is there ever likely to be, a standardized form of organization for a design or engineering department, but in the successful operation of such a department, there should be discernible those underlying principles which will find their counterpart in great measure in any progressive industry. A good organization is nothing more than a well coordinated piece of machinery, requiring continual executive attention to keep operating smoothly—it is not a perpetual motion machine, which once started, can be expected to run on evenly forever, without the aid of external power, lubrication, adjustment or overhaul. Any systematic scheme of acquiring statistics in an organization must stand the economic acid test: "Is the information so acquired worth the cost of acquiring it?"

How Executive Staff Functions

The major executive function of a design department is generally exercised by a chief engineer, an assistant chief engineer or project engineers (if that system is used). The project engineers are on their projects or jobs the representatives of the chief engineer and his assistant, and whether they are so designated or not, they are a part of the general executive staff. Many organizations use the equivalent of the project engineer, differing chiefly in the title assigned him rather than in his function. The project engineer system of organization has been developed for and is particularly adapted to large organizations which produce

THIS is the first of a series of six articles on the organization and supervision of design departments by John F. Hardecker, chief draftsman of the United States naval aircraft factory. Many other interesting phases of this subject will be presented in later issues. The second article will deal with systematizing to increase efficiency, standardization from its practical aspect, and some possible disadvantages of these methods.

many varied products, some closely related to each other and others not at all, some on a production and others on an experimental basis. It provides the most flexible type of technical organization yet devised and successfully carried out in actual practice. It lends itself readily to the machinery industry, shipbuilding, locomotive industry, automotive and electrical manufacturing; in fact, any large organization manufacturing a variety of mechanical or structural products.

To those familiar with the workings of a large organization such as outlined above, it is at once apparent that the cardinal problem is to have all jobs, large or small, followed up from their source so that they are not lost sight of, at any time, or unduly delayed; also that at all times there shall be some one in the organization who can quickly and fully give information and render technical decisions, and who is conversant with the exact status of the job in the organization. Fundamentally this man, known as a project engineer, is the "clearing house" for information and action, and is the hub of the wheel about which the organization revolves on the jobs assigned to him as his projects.

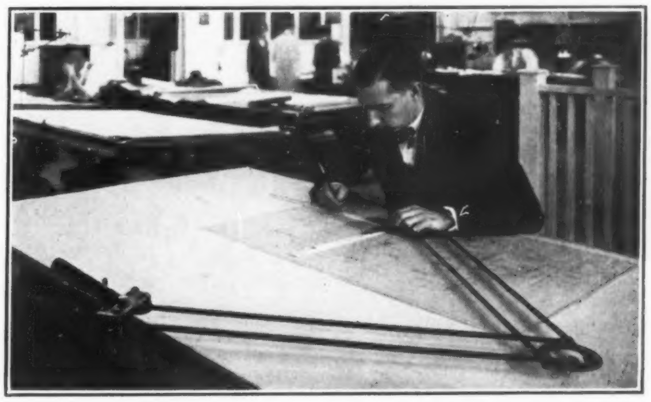


Fig. 1—Universal drafting machine in use. Note ease with which appliance can be manipulated

The foregoing represents the general executive function of a design department. The detailed direction of the department in turn should be concentrated in one head, who for the purpose of proper identification will be designated as the chief draftsman, although this title may vary with different organizations. The chief draftsman is responsible for the proper execution of the work engaged in by the department, the personnel distribution and the maintenance of determined policies. He is the operating head of the design machine.

The Department Subdivided

The subdivisions of the department are influenced considerably by the nature and type of design work undertaken. The following basic subdivisions all should find a counterpart in any design organization, with due recognition of the fact that in a small design unit it may be advisable to combine certain functions.

The mathematical section is primarily concerned with the preparation of stress analyses, capacity calculations and all general mathematical, mechanical or electric analyses used in design, serving as a source of detailed information.

The standards and specifications section primarily develops standard parts and specifications on materials, shop processes and finishes, serving as a source of general information on such matters for the purchasing department as well as the design department. It is the source of detail design contact with the sources of information on new materials, processes and finishes with general industry.

The drafting section utilizes the information prepared by the mathematical section and the standards and specifications section in the detailed development of designs to meet the specified requirements established by the chief engineer or his staff assistants. This section is the engineering production unit. Being by far the largest subdivision of a design department, it may well be further divided for convenience into units based on the types of design work.

The checking section checks the work of the above mentioned sections, serving as the inspection unit of the department.

The weight control section, peculiar originally only to aircraft and other special producing units, is now finding increasing use in a wide variety of producing firms, wherever excess weight represents decreased performance and material waste.

The blue print and record section reproduces in such quantities as required by the work of the other sections, distributing the same to the various departments concerned. This section further keeps records of all design data, whether in the form of blue prints, data sheets, letters, etc.

The purely experimental design department is a valuable adjunct of many organizations, but it is believed that the best interests of the concern as a whole often are most readily served by utilizing the personnel of the regular engineering division for this purpose, thereby gaining greater coordination with practical design, greater flexibility of personnel, and quicker determination of results. In such cases, an experimental shop, physical testing laboratory, chemical laboratory, metallurgical laboratory, etc. as required should be available.

In the administration of a design department,

the delegation of work should be under the direct supervision of the chief draftsman. Orders issued by the chief engineer or other staff assistants should always pass through the hands of the chief draftsman. He should be the central point to which all personnel look for their major orders. The cardinal principle of all good design orders is to tell a man what is wanted, rather than how to do it. The man who is told what is desired puts to its accomplishment all his personal assets, while the man who is started off step by step being told merely how to do it, often cannot bring into action his own resources because he may not even know what the ultimate objective is. The proper development of personnel is one of the greatest responsibilities of those charged with the administration of the department.

Development of the Personnel

In general, it is always best to plan to develop the potential leaders of the engineering department from its own personnel. Occasionally it may be expeditious to import outside personnel for the higher positions, provided the man so introduced brings to the organization some new specific experience not otherwise obtainable. But we must not lose sight of the fact that the prospective employe exploits only his good points in selling himself for the job, while his faults often remained unrevealed. The man within the organization, despite certain weaknesses that have been discovered, may be a far better prospect for the higher position than the new man from outside.

Unless there is held forth a reasonable prospect of promotion, the organization cannot attract nor continue to hold the best type of personnel. No really capable man will continue to break in new men over his head, if he conscientiously feels that they are no better trained or equipped for the position than he is. Proper supervision does not make this matter of promotion mere guess work, but it continually provides small ways and means of testing out a man's potential ability for bigger things. Every key job or position of responsibility should be properly understudied, whether the understudy bears any title or not, or whether he is even directly conscious of this relationship.

Selection of New Men

In selecting new men to build into the organization, as far as is consistent with circumstances, they should be taken into the organization in the relatively minor positions. In the selection of men lies the greatest single action on which the foundation of a good design department is built. No man, no matter what the position he is hired for, should be taken in solely on his qualifications for the immediate position, but rather on his potential possibilities. A tracer should be hired not only on his qualifications as such, but on his possibilities as a future detailer, designer and ultimate supervisor.

The university graduate in engineering is always a good prospect. True, his practical knowledge of drafting may be rated as almost nil, but he does have a splendid all-around technical training. It always should be borne in mind that you can readily enough teach a man the craftsmanship of drafting, but you cannot give him the technical foundation represented by college mathematical, scientific and technical courses. The university graduates sometimes start slowly, for after all there are many readjustments in their lives directly after graduation; but there is no denying that they will go farther in a reasonable period of time than the same number of practical draftsmen who lack this fundamental training in creative imagination and reasoning power.

It is not to be assumed that the foregoing is a brief for the college graduate in design work. It only represents an opinion of the value of a reasonable number of college men in any design organization. Another splendid source of valuable design material is the young man in the shop, who not only shows promise in his trade, but who is also at the same time ambitious enough to further his education at night school or by correspondence courses. Such a man should be given every encouragement, as he makes splendid design material.

First Interview Is Important

Then of course, there is the man who has attained reasonable practical success as a designer in other organizations. Much can be learned about him in the first interview—particularly from his explanations for leaving his previous positions. Many a man who has the paper qualifications inadvertently will disclose certain queer personal traits that will reveal him as unsuitable for inclusion in a well functioning harmonious organization.

Character is one of the important assets of a good designer. After all, it is not how much a man knows, but rather how well he applies what he knows in cooperation with others. Design work is often of necessity confining and trying, and a good disposition and healthy body are invaluable assets. A pleasing personality is just as valuable in a drafting room as it is in other branches of industry.

A design department should be located in light airy floor space, with pleasant surroundings, preferably on a top floor. With the exception of laboratories, full open space for all the sections is preferable to closely subdivided rooms. Ac-

cessibility to the shops is an important feature, as much is to be gained by close intimate contact for all design personnel with the progress of work in the shops. The physical separation of a design department located in a different city or town from the factory, convenient as it may be to certain major general executives, is a severe handicap for any good design department to overcome.

Good substantial furniture and equipment creates a feeling of confidence and permanence in the minds of the employes. Good indirect lighting for the entire room, rather than individual lights on drafting tables, is preferable. The individual light unless constantly adjusted, either gives too much or too little light on the work most of the time. Framed photographs about the walls of actual constructions, machines or products designed by the organization, are really well worth their cost, through the company spirit they foster.

While T-squares still are used to a considerable degree, it is believed that parallel rule attachments or universal drafting machines, one of which is shown in Fig. 1, are worth the small additional investment. They are more accurate, function more positively, and save a great deal of time. Small hand machines for driving wire staples at one blow in fastening down drawings are finding increased favor in lieu of thumb tacks. These staples are removed readily by a knife blade. Drafting tables should be provided with suitable drawers and with covers to protect the work and keep it clean at night.

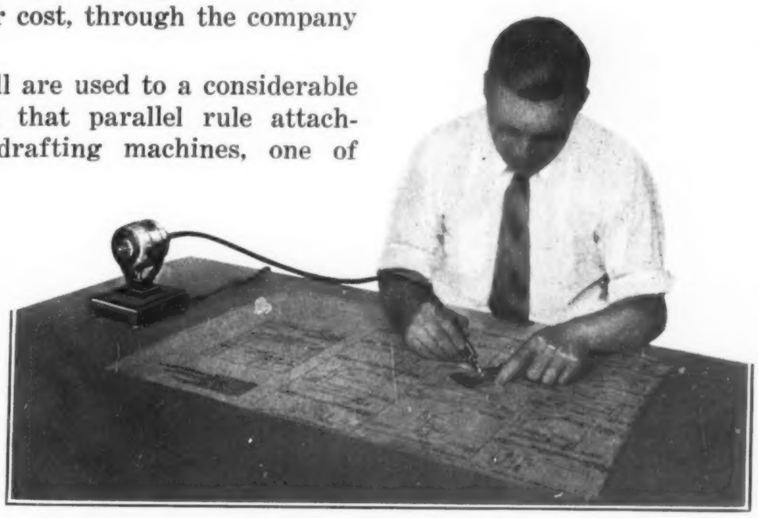


Fig. 2—Many companies use electric erasing machines

Large Drafting Tables Are Essential

In addition to the individual drafting tables, a proper number of extremely large drafting tables should be provided whenever the work of design is such that large scale layouts of complete machines are essential. For these large tables, cloth backed template paper should be shrunk into place. This is done readily by keeping the paper continuously wet while the turned in edges are progressively tacked into place with carpet tacks.

A glass top tracing table, equipped with lights is a valuable adjunct for retracing from blue prints, old drawings, etc. The use of a sheet of celluloid between the glass and the drawing provides a suitable working surface for compass or divider points. Small tracings or blue prints can be attached to the glass with gummed stickers.

The personal equipment of a draftsman should include a good set of instruments, triangles, rules, slide rule and handbooks. Though practice varies, consumable supplies such as pencils, erasers, ink, drawing paper, tracing cloth, cross section paper, thumb tacks, sand paper pencil pointers, etc. are best supplied by the company. In all company-purchased supplies it is extremely false economy to buy inferior goods because of price concessions. In no other division of industry are salaries such a major proportion of the operating costs of an organization as in a design department, yet the work of the best men may be minimized in its value to the production department by the use of inferior equipment.

In addition to the foregoing equipment, there are many other items which form a valuable adjunct to a properly functioning drafting room. These are not supplied to the individual draftsman, but are subject to loan. They vary, of course, in their utility with the nature of the design work, and while all that are cited may not find their place in any given drafting room, and the number of units to be available varies with local conditions, all are worthy of consideration.

Such equipment may include beam compasses, splines and spline weights, ship curves, railroad curves, proportional dividers, planimeters, large protractors, calculating machines, special lettering pens, large flat steel rules for layout tables and steel tapes. An electric erasing machine for ink erasures, as shown in Fig. 2, is a great time saver and makes possible work that otherwise could not be done. Most organizations will find calipers, micrometers, thread gages, radius gages, height gages and a surface plate of real value. Certain organizations will find surveying equipment such as transits, levels, surveying tapes, etc. a necessary investment. Any mechanical aid in the form of a standard tool or special tool is a good design investment, for the time of designers is valuable and tools in their hands are assured of adequate care and proper use.

How Castings Meet Designers' Needs in Modern Machinery

By Dan M. Avey

> FROM giant forming presses to small machines requiring the most minute accuracy, castings may be found to form supporting members or actuating mechanism. Proper selection to perform the designated service is the function of the design engineer.

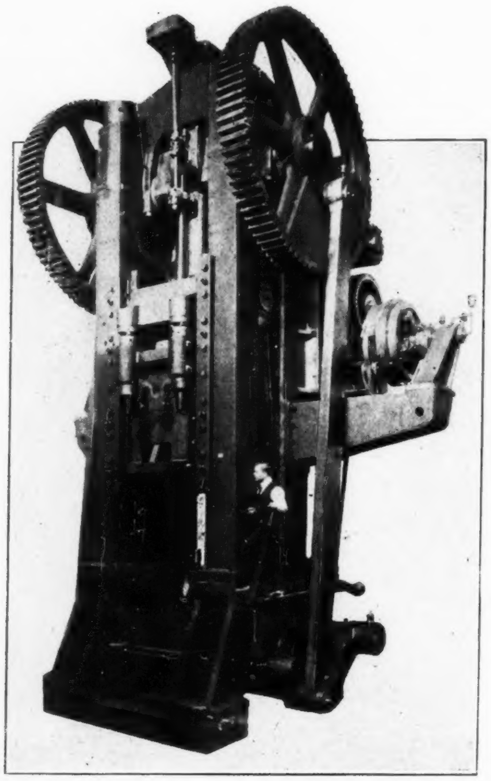


Fig. 1—Heavy supporting framework and gears for working parts are castings

DESIGN materializes ideas. The designer by putting to work the materials at hand accomplishes a transmutation which changes human thought to actual physical objects whether the result be a building, a bridge, a machine, or a mere mechanical detail. He spans the gap between imagination and reality and makes actuality of dreams.

The art of casting metals owes much to the designer and good principles of design long have depended upon castings to make ideas workable. And castings ever have served the advance of civilization. The crude bull hide and wood shields of the barbarians offered slight resistance to the cast bronze points of Roman lances. Mail-clad feudal knighthood fell before the blast of cast-iron shot fired from cast-iron or brass cannon. Serfdom could not withstand the onslaught of mechanical farming. Human liberty has followed the advance of the printing press, the steamship, the railroad and the multitudinous machines which have lightened labor and lifted the load from the human back.

To one with sufficient time and inclination, tracing the part played by castings in every marked advance in the human race will form an entrancing study. From the ancient masterpieces of bronze sculpture to the modern intricate automatic machine the method of fabrication known as casting has proved indispensable to the man who materializes ideas.

Fundamentally no other method fits itself so well to shaping metal to any required form. A blocky section here, a thin web there, a boss, a bracket, a recess, an irregular opening, a flat plane, a circular arc, a warped surface, gear

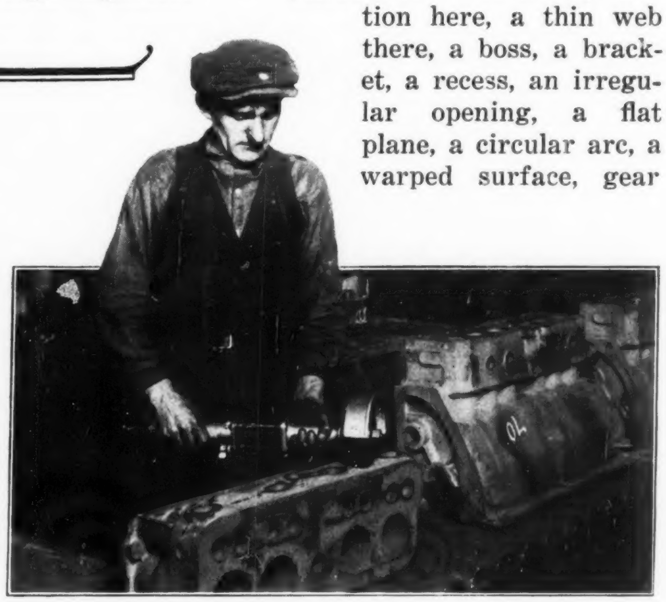


Fig. 2—Castings are employed where lightness, ease of handling and durability are essential, as in a pneumatic grinder

teeth of any pitch and spacing, a fillet, an angle, a channel, a bead, any figure, letter, character or feature—all are possible by molding the part in sand or other medium and pouring in molten metal possessing the required properties.

Affords Choice of Physical Properties

With this variety in form, the designer has available to materialize his ideas an infinite range of physical properties awaiting his selection. This selection is an important consideration and successful realization of an idea depends upon the exercise of engineering knowledge of cast metals and an application of judgment in using them. After all, the real test is whether a machine will work and whether it will survive in service long enough to make its purchase economical from a business standpoint. A thorough knowledge of physical properties of castings may be obtained from existing specifications, from the literature of the foundry industry, and by consultation with manufacturers of castings. The latter have proved singularly resourceful in meeting the more and more severe demands of designers. They have sought and found better metals for increasingly severe service, and their advice should be sought and will be freely given to the designer who faces a new and knotty problem.

Fundamentally, castings are divided into two main classifications comprising ferrous and non-

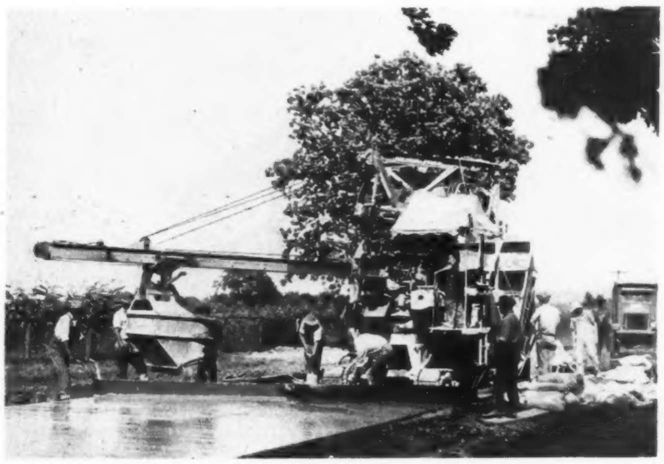


Fig. 3—Rough and rugged going in modern road building activities demands strong dependable castings

ferrous metals. In the first may be found gray cast iron, with its subdivisions of semisteel and various special alloys and products made by special treatments. The next division is designated as malleable cast iron. The third is cast steel designated as plain carbon or alloy steel, each with its special heat treatments.

Nonferrous castings are many and varied. They include red and yellow brass, bronze, bearing metals, a wide range of alloys of aluminum, nickel, magnesium, lead, antimony and zinc.

Each classification has its range of service with certain merits and limitations which fit it for the requirements of proper design. Acquaintance with physical properties will enable the designer to designate the right kind of casting for each purpose. The twilight zone, which borders between the different kinds of castings where cost

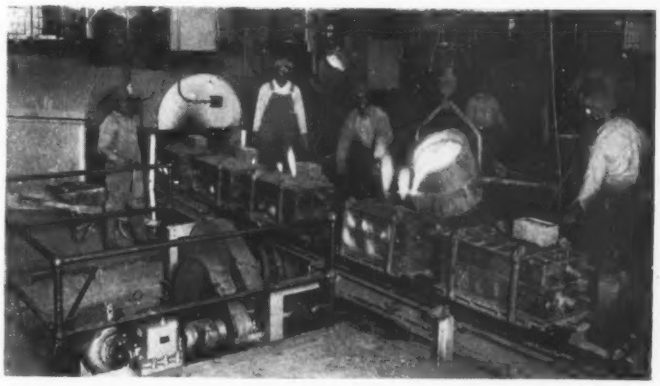


Fig. 4—Abrasion and heat encountered where hot metal is poured impose severe service on conveyor systems

must be weighed against long life and where strength must be measured against ease of machining, constitutes the only place where the light of accurate knowledge must show the way to good design. In this twilight zone, the designer should consider the probable life of the casting not only from the standpoint of replacement cost, but also he should estimate the cost of disassembly and reassembly, the loss due to idle time due to breakdown, and the effect upon a continuity of operations or a chain of processes, should a part fail.

Ready Replacement

A case in point is furnished by a builder of a foundry conveyor system. A cast-iron sprocket wheel was adequate in strength and long life for ordinary service in a chain belt driving the conveyor. However, pieces of scrap, designated as tramp iron, in the sand which this conveyor handled occasionally jammed between the sprocket teeth and the chain, resulting in broken teeth on the wheel. This firm redesigned the sprocket wheel, supplying a plain wheel with segments carrying cast-steel teeth bolted in place around the rim. This cut down the breakage and when teeth were broken, a new segment quickly was bolted in place without difficulty in tearing down and rebuilding a part of the conveyor and without undue loss due to idle time and interruption of the movement of materials required in various succeeding manufacturing operations.

The physical properties of castings may be divided as follows: Strength, toughness, soundness, durability, weight, appearance, electrical conductivity, and power to retain magnetism. Strength is determined by compression, transverse, tensile, shear, torsion and endurance tests. Toughness is measured by resistance to change of shape, return to original shape after distortion, resistance to shock or impact, and ability to undergo twisting or pulling forces without breaking. Soundness is the property which permits castings to retain fluids, either liquids or gas without leaking. Durability is resistance to wear or corrosion.

ACCURATE knowledge of the characteristics of the materials used in engineering construction is of course essential to the designer. Technology is advancing so rapidly, this necessitates a constant search for information. In the case of such a common material as cast iron the designer who relies on information based on conditions only two or three years ago is really working with antiquated specifications. The accompanying article is the first of several by prominent authorities which will deal with various phases of the application of castings to machine construction from the standpoint of the designer. Mr. Avey, as editor-in-chief of The Foundry, is unusually qualified to present this introductory article. Those to follow will deal specifically with the characteristics and application of various kinds of castings including gray iron, steel, malleable, and nonferrous metals.

Gray cast iron is one of the oldest known casting metals. Traces have been found which indicate that cast iron was known in Oriental countries before the fourteenth century. European countries first used iron castings for domestic utensils, firebacks and ornamental purposes.

Gray cast iron as known today covers a wide range of alloys and its method of manufacture is varied to secure certain properties which are sought. Fundamentally, cast iron is a combination of iron with carbon with various amounts of other elements such as silicon, manganese, phosphorus and sulphur. Nickel, chromium, molybdenum and other rarer elements frequently are used to secure certain effects in the cast product. Fundamentally the material which governs is carbon. When the percentage of carbon in the iron is below 2 per cent, the material is known as steel and when it is above that point it is cast iron.

In gray cast iron carbon is held in solution in the molten state, but is precipitated in the form of flat flakes like mica when the metal freezes in the mold. The condition of the carbon, namely its flake-like form, results in weakened planes which interfere with one property, namely strength. To the designer, this condition is of importance only when a part is subjected to strain in some other form than compression. Gray cast iron has high compressive strength and it may be obtained today in tensile strengths ranging from 18,000 to perhaps 60,000 pounds per square inch, but probably 25,000 to 30,000 pounds is a fair average unless special high strength cast iron is specified. The transverse strength of cast iron also may be made to vary widely from 2500 to 6900 pounds per square inch, and the hardness which varies inversely with the machineability, although not in direct proportion, may be varied by the increasing or decreasing of different alloy elements or by hastening or retarding the cooling of the iron in the mold. The compressive strength of cast iron varies from 80,000 pounds to 150,000 pounds per square inch.

Although the element of toughness is not possessed by gray cast iron, castings may be made which are thoroughly sound, of good appearance and possessing a wide range of electrical properties depending upon alloying elements. Cast iron is obtainable today which is nonmagnetic, a factor of importance where signal equipment or electrical control machinery is manufactured.

Cast iron does not deteriorate rapidly under normal corrosion conditions as has been proved by cast-iron pipe which has been found in good condition after more than 100 years in service underground. Special alloys of cast iron are available which are resistant to commercial acids, mine waters, and the extraordinary hazards of machinery used in the chemical, tanning, fruit preserving and allied industries.

Wear resistance of cast iron under certain conditions is remarkable. A case in point is the modern automobile cylinder which is subjected to sliding friction of cast-iron piston rings and which gives remarkably long service. Slideways on machine tools afford an example of a similar property of gray cast iron. For more severe wear, so-called chilled iron which results from rapidly cooling the surface of certain types of gray iron castings finds wide use. Cast-iron car wheels are manufactured by the thousands. Die blocks, gears for certain service, scrapers and conveyor buckets and other sundries employ chilled cast iron.

To the manufacturer of machinery, cast iron has been immeasurably valuable. Where bulk and inertia are important the uses of cast iron are thoroughly familiar. Frames and bases of machine tools are made of cast iron in exceedingly intricate and involved form and with surprising accuracy to finished dimension without undue

machining. However, machining time is a minor consideration in ordinary gray iron as the material cuts rapidly and when properly made produces a smooth and accurate surface which shows regularity and fine grain under the microscope. Its low cost recommends it for general purposes, limited of course by the physical properties and by the detailed method of manufacture. During the past ten years the manufacture of gray iron castings has made enormous strides, and accomplishments possible today with this material were undreamed of at the close of the World War.

What Is Malleable?

Malleable cast iron as known in America is a development dating back to 1820 when a method was discovered by Seth Boyden, an inventive genius of Newark, N. J. Malleable cast iron differs in many chemical and physical constituents from gray cast iron, but for the layman the essential difference is in the form in which the carbon is found in the finished product, the malleable iron casting. Due to the original chemical content, the method of melting and finally, the method of annealing, the carbon in the iron is changed to a form known as temper carbon. Instead of being uniformly disseminated as little flakes as is the case in cast iron, the carbon in malleable iron is curled into globules which do not afford the starting point for a plane of cleavage under certain stresses. For this reason toughness is imparted and the general range of strength of malleable cast iron is above that usually attributed by engineers to gray cast iron.

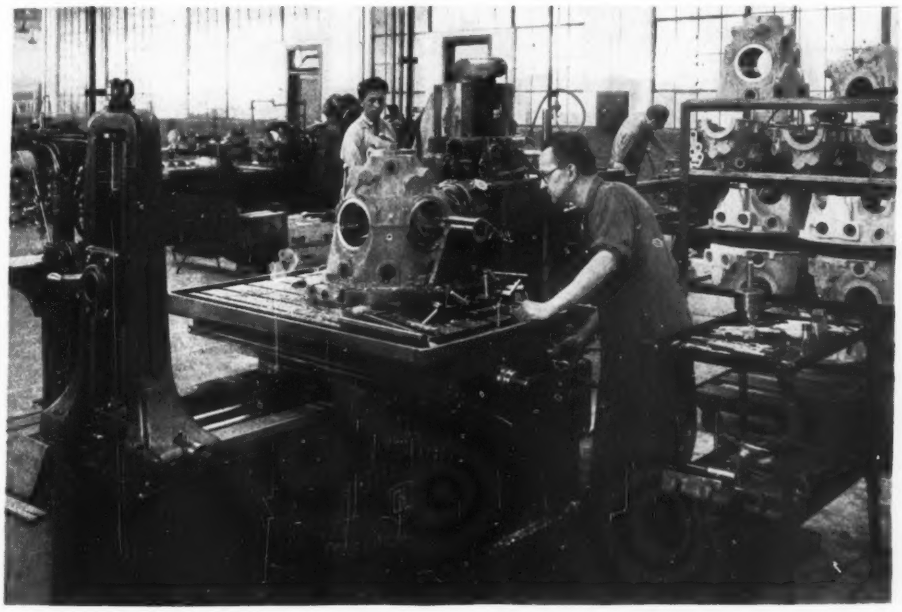


Fig. 5—Speed in machining and adaptability of form recommend castings of various types. Rapid cuts in gray iron produce smooth and accurate surfaces

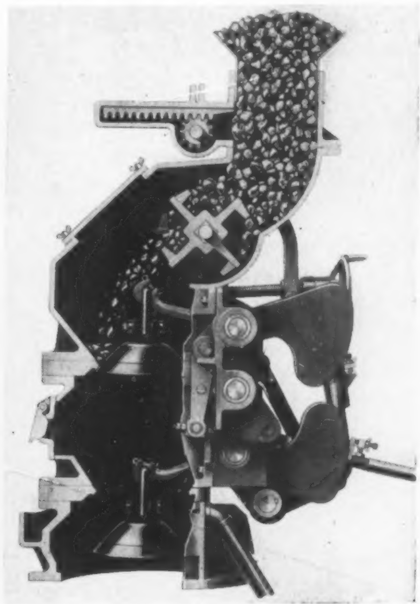


Fig. 6—Castings may be adapted to innumerable changes of thickness and form

Today, commercial malleable castings are available in remarkable uniformity to a standard. The average range of tensile strength is from 50,000 to 60,000 pounds per square inch. An elongation of 25 per cent in a 2-inch section is not by any means uncommon.

Malleable cast iron machines freely and its toughness has recommended it for a wide range of service. The material is durable, of good appearance and has a high resistance to ordinary corrosive actions. In fact, corrosion resistance is the physical property which recommended malleable for service instead of rolled steel in tie plates, fish plates and track fastenings for bridge track work where the drip from refrigerator brine quickly deteriorated other materials and where replacement costs were high.

First Used for Harness Parts

It is interesting to note that in his book *American Malleable Cast Iron*, H. A. Schwartz, Cleveland, states that probably the first application of malleable was in the manufacture of buckles and harness parts where lightness, strength and toughness were paramount. Subsequently, wagon parts were made of malleable and by natural transition the service of malleable castings in the automotive industry was identified with the advance of that important manufacture in America. Automotive manufacturers are among the largest users of malleable castings. Similarly, agricultural implements and farm ma-

chinery consume large tonnages of malleable castings.

In the manufacture of malleable castings annealing is an essential step and since the effect of the anneal is limited to light sections, the greater use of this material is to be found where light, tough, and strong parts are desired. For this reason with the increasing weight of railway rolling stock, steel castings have been substituted in some cases for malleable.

Malleable Used in Conveying Equipment

One of the most important fields of service of malleable castings is to be found in conveying machinery. The design of chain belt drives and many factors in modern conveying systems would have been impossible without the use of malleable castings. In the machine tool industry hand wheels, cranks, levers as well as jacks, wrenches, and small hammers commonly are made of malleable cast iron. Cable clamps, transmission fittings and many small parts of electrical machinery also demand malleable.

Steel castings are made in several grades varying fundamentally in relation to the per cent of carbon. Where carbon varies from 0.15 to 0.20 per cent, the material is known as soft steel. Hardness and strength increase in steel castings up to those which carry 0.50 to 0.60 per cent of carbon and in few special cases the carbon is higher. Practically all steel castings as made today are heat treated both to allay initial strain and to vary the strength, and other properties. The other common elements which affect the physical properties of cast steel are silicon, manganese, sulphur, and phosphorus. Special alloy steels are available to give a wide range of physical properties.

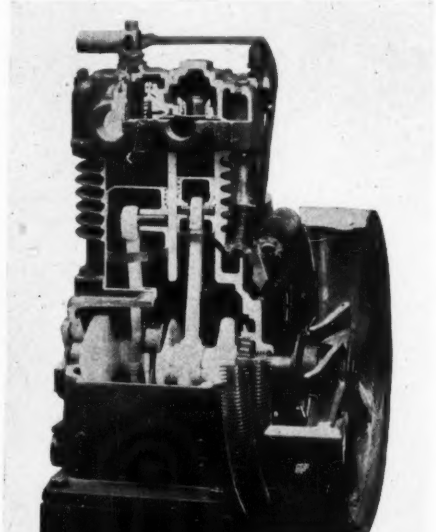


Fig. 7—Fly wheels, pistons, cylinders, cylinder head and base in small compressors are made of cast iron

The tensile strength of cast steel may be varied from 60,000 to over 100,000 pounds per square inch, while the elongation averages from 20 to 30 per cent in a 2-inch specimen. Cast steel is exceedingly tough and under shear test, according to John Howe Hall, High Bridge, N. J., gives a strength equivalent to two-thirds of the ultimate strength. The toughness may be varied by the addition of certain elements, notably, manganese. Manganese steel castings occupy an unique position where toughness is paramount. They find service in grinding rock and similar hard material, in crusher jaws, dredge and steel shovel lips and teeth, ratchet and pinion movements on heavy machinery and special gear and pinion service.

Steel castings other than special alloys are widely used in truck and other automotive service, as track plates on the caterpillar type cranes and road machinery, screws for screw feed machines, buckets on conveyors, operating parts on special braking devices for cranes and handling machinery, on heavy presses and shears, and similar points where severe service is encountered.

Nonferrous castings are coming into wider service in machinery lines. Where lightness and strength are sought special alloys of aluminum are available. Toughness such as is required in worm and pinion drives will be found in alloys known as aluminum bronze. These today are cast in semipermanent molds so close to finished dimension that little machining is required. Bearing metals, ranging from the common babbitts to special oilless bearings, are being cast by a greater number of outstanding foundry firms. Small fittings, screws and bolts, valves and pump parts are available in a wide variety of copper base alloys. Where corrosion resistance is a factor almost any corrosive element may be conquered by special nonferrous alloys.

The foundry industry has learned many valuable lessons from the design engineer. Similarly, the foundry industry has met every demand of the designer. Points worthy of consideration will be developed whenever the machine designer finds it possible to spend some time in consultation with an enterprising foundryman. Modern machine methods of molding have brought greater accuracy in castings as made today. Consequently closer machining tolerances are possible and in many instances a marked reduction in costs will result when the designer takes the foundryman into his confidence. In this connection each casting which is specified should be regarded as a finished piece of engineering design and construction. The basis of buying castings by the pound prevalent for many years has been a handicap to the designer, a hindrance to the machine builder and a curse to the foundry industry.

Calculating Costs of Belts, Pulleys As Complete Driving Unit

By John Flodin

Assistant Professor Machine Design, University of Minnesota

MATERIALS used for belting are, with very few exceptions, leather, woven cotton or folded cotton duck, rubber, and balata. Of these, oak tanned leather is most commonly employed, and its properties are so well known and information about it is so readily obtainable from texts on machine design, from handbooks, and from catalogs, that any discussion of it here would be superfluous.

Mention should be made, however, of the special process beltings, which usually are oak tanned leathers retanned by means of mineral salts. These manufacturing methods yield a somewhat stronger and a considerably more flexible belt, the latter quality facilitating the use of smaller pulleys without injury to the belt, as indicated in Table II. Special combinations of leathers, such as oak tanned belting with longitudinal chrome tanned strips on the inside of the belt are being advocated by some engineers. These devices are usually not without merit, either because of the increased friction between the belt and the pulley that they offer, or because of the increased durability of the belt; but it is by no means always certain that the advantages that may be secured by their use will warrant the increased cost.

Untreated cotton contracts very materially with increasing moisture, so that belting of this kind should never be used in wet places, and preferably not where the atmospheric humidity is not controlled by reasonably adequate air conditioning. Because of its lower first cost, untreated cotton is sometimes used for temporary drives and for drives that will be idle much of the time, but in such cases the saving in first cost is often offset by the low salvage value of cotton belting.

Impregnated or treated cotton belting, whether it be woven belting or folded and stitched cotton duck, is effectively rendered waterproof by the process of impregnation. Many substances are used for this purpose, the aim being not merely to make the cotton impervious to moisture, but also to reduce the wear on the fibres, with a minimum interference with the flexibility of the belting.

Rubber and balata belting should be discussed together because of their general similarity. They are made of cotton duck treated with rubber or

Table I

Minimum Pulley Diameters for Treated Fabric and Friction Belting in Average Service, in Inches

Belt Velocity in Feet Per Minute

	Friction Rubber Belting			Stitched Duck Belting			Balata Belting		
Number of Plies	0 to 2000	2000 to 4000	4000 to 5000	0 to 2000	2000 to 4000	4000 to 5000	0 to 2000	2000 to 4000	4000 to 5000
3	2	3	6	3	4	6	2	3	5
4	4	8	12	4	5	7	4	6	8
5	10	14	18	5	6	9	8	10	12
6	16	20	24	8	10	12	12	14	18
7	22	26	30	12	14	18	16	18	22
8	28	32	38	16	20	24	20	22	26
9	34	38	44	22	28	36	24	26	30
10	40	44	50	30	40	48	30	32	34
12	52	56	64	52	68	76	36	40	42

balata which is forced into the fibres from both sides under heavy pressure, whereupon the fabric is folded to make belting of the required width and number of plies, and again subjected to heavy pressure. Rubber belts are vulcanized while balata belts are not. Since either of these materials gives an excellent wearing surface the belting is often heavily coated, especially on the wearing side. This is particularly advantageous for conveyor service, for which this type of belting is well suited. The rubber or balata used for binding together the layers of canvas is sometimes called the "friction" of the belt, so that belting of this type has become known as friction belting. The fabric is in all cases depended on to give the tensile strength to the belt.

Balata is so much like rubber that it is often mistaken for it. Indeed, when balata was first discovered it was thought to be rubber, though possibly of an inferior grade that would require somewhat different methods of manufacture. So was gutta-percha also at first mistaken for rubber.

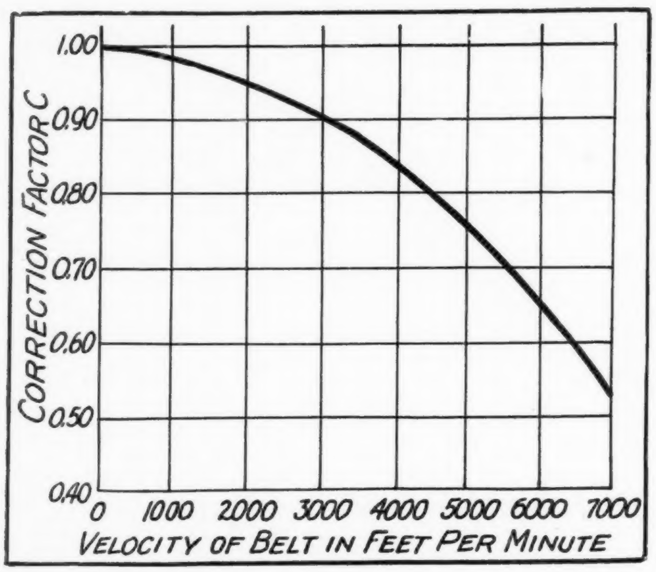


Fig. 1—Correction factor C covering centrifugal force, for use in belt width formula

Rubber, vulcanized or in the natural state, oxidizes when exposed to the air, forming a surface "bloom", which gives it the familiar chalky appearance. Under proper conditions this oxidation penetrates only very slowly into the body of the rubber, but if the belt is exposed to moisture and heat or to strong sunshine, the deterioration is fairly rapid. It is fairly resistant to acids, but fatty and mineral oils, especially benzine, turpentine, and alcohol are destructive to it. It is possible, however, to produce oil resisting rubber belting by special processes of vulcanization of the surface coating.

Gutta-percha has an elasticity about the same as that of soft leather but is very flexible. If exposed to the air for any great length of time, it becomes resinous, hard and brittle. For this reason gutta-percha should not be used for belting, nor is it now so used to any considerable extent.

Balata has very nearly the elasticity of rubber and the flexibility of gutta-percha. It is extremely tough, is not affected by the atmosphere (does not oxidize), but it is affected by mineral oils and by the stronger acids other than nitric acid. Unlike rubber, it cannot be vulcanized.

The greater flexibility of balata as compared to that of rubber suggests that balata belting can safely be run over smaller pulleys than rubber belting. This is indeed the case, as will be seen from Table I. The minimum size pulley over which a fabric or friction belt may be run does not, however, depend on the flexibility of the belt alone, but also on the danger of "bootlegging", or the failure of the friction, which causes the layers of fabric to separate from one another. The belt speed therefore becomes a factor in determining the minimum size of the pulley, as given in the table.

Table II gives a summary of the suitability of belts of different materials for a fairly wide range of driving conditions. "No" in this table means that the belt named in the column heading would probably not prove successful under the conditions at the extreme left of the table, while "Yes" means that the belt is suitable for use under those conditions. The data for this table have been gathered mainly from practice. Because of the necessity to cover each case by only a single word some of the "No's" perhaps are too severe. For example, other than leather belts have been used for twisted drives with complete satisfaction, but such installations very often give trouble—hence the "No's" in all three columns at the extreme right of the table, in the line marked "For ½ twist and similar drives."

Belt Width Necessary for Given Horsepower

The theoretically correct expotential formula for the power transmitting capacity of belts, or for the width of belting necessary to transmit any given power under known conditions, is often avoided by practical engineers, reliance being placed on the more easily handled empirical formulas. The empirical formulas fail, however, to take into account two sources of error which may be quite significant. The first of these is that due to the centrifugal force, which tends to lift the belt away from the pulley, thus decreasing the friction between belt and pulley and therefore also decreasing the amount of power that can be transmitted per inch of width of belt. The effect of the centrifugal force may, however, be

taken care of quite conveniently by introducing a correction factor *C*, as shown in Fig. 1, into the rational formula, and it is well to do this except in cases of relatively slow speed driving—up to belt speeds of 1500 or 2000 feet per minute—where the effect of the centrifugal force is small.

The second source of error is that due to the change in the arc of contact. Most empirical formulas are based on the assumption that there is contact between the belt and each of the pulleys through arcs of 180 degrees, but where the diameters of the two pulleys are materially different the arc of contact on the smaller pulley may be very much less than 180 degrees if the belt is open, so that the traction is correspondingly reduced. In other cases, notably with crossed belts and with open belts where tightening idlers are used, the arc of contact on belt pulleys is greater than 180 degrees. In long spans the arc of contact approaches 180 degrees whether the belt is crossed or open, provided the difference between the diameters of the pulleys is not large, and no correction need be applied. But in drives of moderate span and relatively high speed reduction, the correction for the arc of contact should be applied. This may be done by using a second correction factor, *K*, which is shown in Fig. 2.

Table II

Guide For Choice of Belting

	Kind of Belt / Operating Conditions	Leather Belts: Oak Tanned: Single Nonwater Proof	Light Double Nonwater Proof	Med. & Hvy. Double, Nonwater Proof	Waterproof	Special Tannage: Single	Light Double	Medium Double	Other Than Leather Belts: Friction Rubber	Stitched Duck, Impregnated	Balata (Duck) Note 1
Power	Heavy	No	No	Yes	As for Nonwaterproof of same Thickness	No	No	Yes	Select Thickness to Suit Power Requirement, See Formula and Table IV		
	Medium	No	Yes	10 H.P. & Up		Yes	Yes	Yes			
	Light	Yes	Yes	No		Yes	No	No			
Mechanical	Desirable Width	5" Max.	8" Max.	2½" Min.		5" Max.	6" Max.	....	Commercial Widths		
	Least Pulley Dia	3"	6"	10" Med. 16" Hvy.		1¼"	4"	6"	See Table I		
	With Stepped Cone Pulleys	Yes-Up to 3" Width	Yes-Up to 6" Width	Yes, up to 8" Width		No	No	No	Yes	No	Yes
	With Shifters			Yes, up to 10" Width		No	No	No	See Note 2	See Note 2	See Note 2
	With Automatic Tighteners	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
	For ½ Twist and Similar Drives	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Chemical and Physical — In Presence of	Mineral Oils or Greases	No	No	No	No	No	No	No	See Note 3	Yes	No
	Cutting Compounds	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Acids and Their Fumes	No	No	No	No	No, except in Very Small Quantities			See Note 4	No	No
	Strong Alkalis	No	No	No	No	No	No	No	Yes	No	Yes
	Atmospheric Moisture	Normal Indoor Atmosphere Only			Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Water	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Steam	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Max. Temp. Deg. Fahr.	115	115	115	115	115	115	115	180	140	100

NOTES
1. Balata belting should not be used where there is danger of sparking due to static electricity.
2. Duck belting gives satisfactory service with belt shifters if the latter are fitted with rollers.
3. Use only belts finished with special mineral oil resisting stock.
4. Use only belts finished with special acid resisting stock.

The power transmitting capacity of a belt is expressed by the fundamental formula

$$33{,}000 \times \text{H.P.} = V \times t \times b$$

where V is the belt velocity in feet per minute; t is the effective pull of the belt per inch of width, or the difference between the tensions in the tight and in the slack sides of the belt, per inch of

width; and b is the width of the belt in inches. Solving this expression for the belt width and introducing the two correction factors gives

$$b = \frac{33{,}000 \times \text{H. P.}}{CKVt}$$

the values for C and K being taken from Figs. 1 and 2, respectively. Attention is called to the note given in conjunction with Fig. 2, which explains the manner of finding F, which refers to the scale at the bottom of the graph. Since pulley diameters usually are expressed in inches and belt spans in feet, the graph has been plotted for F-values based on these units, the difference of the pulley diameters being used for open belts, and the sum of the diameters for crossed belts, as explained in the note.

Table III

Values for the Effective Pull *t* for Leather Belting

In Pounds per Inch of Width

Belt	Thickness	Effective Pull
Medium single	About 5/32″	40
Heavy single	3/16 to 7/32″	50
Light double	1/4 to 9/32″	60
Medium double	5/16 to 11/32″	75
Heavy double	About 3/8″	85
Medium 3-ply	7/16 to 15/32″	100

The values for t are given in Tables III and IV. These values are empirical and will give economical, durable belt drives provided the drive is horizontal or nearly horizontal, and provided, in open belt drives, the tight side of the belt is below. In vertical and nearly vertical drives the belt tends to fall away from the lower pulley, which reduces the traction; and in horizontal open belt drives with the tight side above, the arc of contact is decreased below that given in Fig. 2, which is based on the supposition that both sides of the belt are straight lines and tangent to the pulleys. For such drives—drives within 45 degrees of the vertical, and horizontal or nearly horizontal open belt drives with the tight side above—it is therefore well to increase the belt width given by the formula by 25 per cent.

It sometimes happens that over-load or the starting condition is more severe than the full load running condition, so that if the belt is designed for the running condition without proper regard for the most severe loading, heavy slippage may result, with consequent undue stretching and possible burnings or charring of the belt. Rubber and especially balata belts tend to become soft and tacky when the slippage is excessive, some of the surface coating of the belt sticking to the pulleys. If the maximum power requirement cannot be estimated reasonably correctly, it is well to calculate the belt width on the basis of full load running conditions and increase the width so found by 10 to 20 per cent.

As explained above, the values for t given in the tables will give durable belts, and therefore generally economical belts because durability means a minimum cost for renewals, for taking up stretch, and for shut-downs. But this does not always mean the best ultimate economy. Assume, for example that a certain belt is run under conditions that warrant the expectation that its life will be 20 years, the working day being 8 hours. If the same belt is in use, say, only 2 hours per day, its life would be 80 years, disregarding the effect of unavoidable deterioration. Long before the end of this time, or of any period approaching it in length, the equipment the belt operates will have been scrapped as obsolete or worn out. For drives intended to be used only a small part of the time, and for temporary service, it is therefore better economy to reduce the first cost of the belt by decreasing its width by from 10 to 30 per cent, the exact amount of the reduction being a matter of judgment. This, incidentally, serves to reduce the width of the pulleys, which means that their cost is reduced; further, the decrease in the weight of the pulleys may mean that smaller shafting and cheaper bearings and hangers can be used, so that the saving in first cost may actually be very materially greater than the saving in the cost of the belt alone.

Table IV

Effective Pull *t* for Rubber, Balata and Duck Belting

In Pounds per Inch of Width, per Ply

Weight of Duck	2 to 4-ply	5 to 7-ply	8 to 10-ply
28 oz. duck	8.5	8	7.5
32 oz. duck	9.5	9	8.5
36 oz. duck	11.0	10	9.5

NOTE: Belting is most commonly made from 32 oz. duck unless otherwise specified.

Economy in the Design of Belt Drives

Reference books state that the most economical belt speeds are between 4000 and 4500 feet per minute, and some books give 4800 feet as the upper limit. These statements are true in so far as the belt itself is concerned, but they are

not necessarily true for the complete drive.

It is not possible to give any general rule or formula for the determination of the belt speed that will give the most economical complete installation. The cost of the belt is a function of its length as well as of its width, and it often happens that when an attempt is made to economize on the width of the belt by increasing the belt speed, the rotative speeds of the shafts remaining unchanged, the pulleys have to be so large that the saving effected in the width is wholly or partly balanced by the cost of the additional length of belting made necessary by the larger pulleys. Furthermore, the lowest possible belt cost, without sacrifice of durability, does not necessarily mean the most economical drive, because the cost of the pulleys must also be considered, as indicated above.

In determining the most desirable combination of belt and pulleys for any proposed drive, the following cost data are useful. It should be understood, however, that if current price quotations are available (both price lists and discount sheets), they should be used in preference to the data here given.

The cost of leather belting, medium thickness, is 24 cents per ply, per inch of width, per foot of length, subject to about 40 per cent discount for highest grade.

The cost of rubber friction belting in cents per foot of length = 4 + 5.4 b + 4.3 bp, subject to a discount of from 60 to 70 per cent, depending on quality. (b = width of belt in inches; p = number of plies.)

The cost of balata belting is very nearly the same as that of leather belting for the same power and the same speed.

The cost of stitched canvas belting in cents per foot of length = 2 + 2 b + 4 bp, subject to discount depending on quality and character of impregnation. (b = width of belt in inches; p = number of plies.)

The cost of cast iron pulleys, finished and balanced, may be taken at 8 cents per pound for medium sizes, but the price per pound is much higher for small pulleys, and somewhat lower for large ones. The weight of cast iron pulleys may be found from the following formulas*, which also are useful in determining the bending moments in shafts. Letting f = width of face, in inches; D = diameter in inches; the weight in pounds, solid, single arm, cast iron pulleys, double belt is

$$0.516\,(D+1)^{\frac{3}{2}} + 0.12\,D^{\frac{3}{2}}(f-3)$$

*These formulas were derived by plotting the unfinished weights of pulleys made by a manufacturer whose product is somewhat heavier than the average, so that the weights found by them are more likely to be high than low. The weights of pulleys are not, however, any direct simple function of their dimensions and the formulas should be regarded as fair approximations only. When actual weights are obtainable, they should, of course, be used.

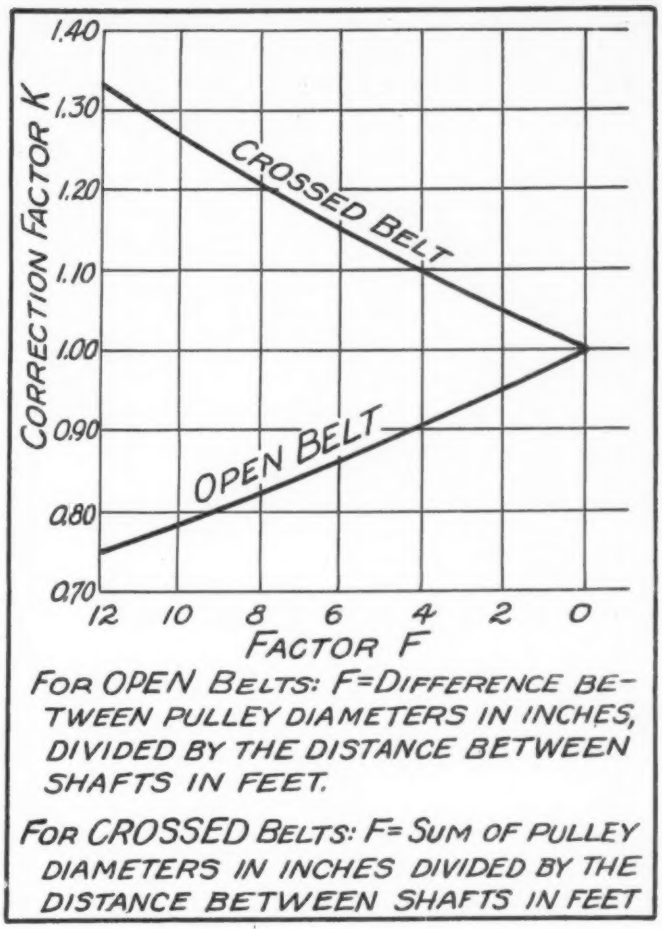


Fig. 2—Correction factor K covering arc of contact, for use in belt width formula

The weight in pounds, solid, double arm, cast iron pulleys, double belt, for diameters 16 to 36 inches is

$$3.3D^{\frac{3}{2}} + 1.35\,(D-1)^{\frac{2}{3}}\,(f-18)$$

The weight in pounds, solid, double arm, cast iron pulleys, double belt, for diameter 40 to 60 inches, face widths 20 to 38 inches is

$$.475D^{2} + 4(D-4)^{\frac{2}{3}}\,(f-18)$$

For split pulleys, both single and double arm, add to the above weights 30 per cent for pulleys up to 22 inches diameter, 25 per cent for pulleys 24 to 38 inches diameter, 20 per cent for pulleys 40 to 60 inches diameter, and 15 per cent for pulleys above 60 inches in diameter.

The following example will make clear the meaning of the cost considerations and the use of cost data. The pulley costs used are from manufacturers' price lists less current discounts, while the belt costs are estimated from the data given above. All cost figures are given to the nearest dollar.

Let it be required to transmit 40 horsepower between two shafts located 20 feet apart, both shafts to make 200 revolutions per minute. The belt is horizontal, open, with the tight side below.

Medium thick double leather belting and split cast iron pulleys are to be used.

Assume, for trial, a belt speed of 4200 feet per minute, which, since it lies between the speeds of 4000 and 4500 feet per minute, should give an economical belt width. The pulley diameters become

$$\frac{V \times 12}{\pi \times N} = \frac{4200 \times 12}{\pi \times 200} = 80 \text{ inches}$$

Such large pulleys for a drive of this power appear grotesque and limitations of space would be likely to prohibit their use. Such considerations do not, however, affect the question of economy. The belt width, from the formula given above, becomes

$$b = \frac{33{,}000 \times 40}{1 \times .84 \times 75 \times 4200} = 5 \text{ inches}$$

and the length of the belt is

$$\frac{\pi \times 80}{12} + (2 \times 20) = 61 \text{ feet}$$

Net cost of belt = 24 x 2 x 5 x 61 x .6	= $ 88.00
Net cost of two 80-inch split cast iron pulleys	= 171.00
Cost of pulleys and belting	$259.00

Repeating the calculation for several belt speeds (in practice it is more convenient to set up the calculations for three or four belt speeds at one time, so that results may be read off the slide rule with but slight changes of the setting) gives the following comparative costs:

Belt speed f.p.m.	Belt width, inches	Cost of belt	Dia. of pulleys, inches	Cost of pulleys	Total cost
4200	5	$ 88.00	80	$171.00	$259.00
3600	5½	92.00	68	108.00	200.00
3000	6	95.00	58	83.00	178.00
2400	8	120.00	46	69.00	189.00
2000	9	129.00	38	62.00	191.00
1650	11	152.00	32	60.00	213.00

In this table commercial pulley diameters have been used, so that the speeds do not correspond accurately with the diameters given. The belt widths are likewise commercial widths.

It will be seen that the cost becomes lowest with 58-inch pulleys, when the belt speed is about 3000 feet per minute. If we had stopped at the first assumption of 4200 feet per minute belt speed, disregarding the awkwardness of using 80-inch pulleys for a drive of this power, we should have paid about 45½ per cent too high a price for the drive. Indeed, it may well be argued that we should drop the belt speed to 2000 feet per minute, paying $13 more for the drive and gaining the compactness of 38-inch instead of 58-inch diameter pulleys. It should also be remembered that the lower belt speed will give a more durable belt. On the other hand, the lower the belt speed, the greater will be the total belt pull (the sum of the pull in the tight and in the slack side of the belt), so that, although the pulleys are lighter, it is quite possible that the bending moments on the shafts are increased enough to necessitate heavier shafting and larger bearings.

Advocates Accuracy and Economy in Setting Tolerances

IT IS believed advisable, in the interests of economy and accuracy, to consult the engineering, production. and inspection departments when setting tolerances. Determination of permissible errors or variations is not always a simple matter, but rather a task that calls for the exercise of unusual discrimination.

It is the designer, especially when freed from the responsibility for costs, who will endeavor to have these variations as small as possible. He will usually insist on a close approximation to the ideal. On the other hand, the man who is responsible for production will reason that the time and cost of manufacturing under certain conditions will increase with the degree of accuracy required; and he naturally will seek to obtain the largest possible allowed errors.

If the situation is dominated by either of these views, trouble is likely to ensue. The unrestricted designer usually demands unnecessarily high standards. Contrariwise, the unrestricted production man usually tends too strongly in the opposite direction. As is usual in such cases, the truth lies between the two extremes; hence the necessity for someone to apply good common sense in the selection of working standards. The best compromise is to be had when the standards are selected by a well-balanced committee on which engineering, production, and inspection are represented. Co-operation in this matter will mean economy and accuracy in production.

—HARRY KAUFMAN

Hypoid Gears Afford Interesting Possibilities in Design

(*Concluded from Page* 21)

there is rolling motion only, the smoothing action is absent.

The most important advantage of large hypoid gears is that the two shafts can continue past each other, which is impossible with bevel gears. The way in which this feature can be applied in machine design is indicated in Fig. 1. A number of hypoid pinions can be mounted on the same shaft, each driving its individual gear. Now that gears with offset axes are no longer represented only by pictures in textbooks, but have become an actuality and are being cut to match one another with the same degree of accuracy as bevel gears, it is believed that this design feature will find many applications.

CLARENCE L. COLLENS,
President, Reliance Electric & Engineering Co.

New Status of Standards Work to Benefit Design

GEORGE K. BURGESS,
Director, Bureau of Standards, Washington

RECENT activities of the board of directors of the American Standards association in connection with the policies and financing of standardization are expected to exert a beneficial influence on all branches of industry. Owing to the importance of national standards in the development of sound machine design practice, the new plans of the association are of unusual interest to those identified with design.

The 12 directors responsible for the present campaign for improved financing of the work of the association assumed office several months ago when the reorganization of the standards body was effected. At that time, the American Engineering Standards committee, which had been organized in 1917 by the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and American Society for Testing Materials, was reorganized under the name of American Standards association.

This change was made to permit the body to keep pace with the growth of the industrial standardization movement in the United States.

HOWARD COONLEY,
President, Walworth Mfg. Co., Boston

WILLIAM J. SERRILL,
United Gas Improvement Co., Philadelphia

The principal features of this reorganization were (a) the definite federation of national organizations, under the name "American Standards association", in such a way that trade associations interested in standardization may more readily join in the direction of the movement, (b) placing the technical work of approving standards in a "standards council", and (c) the concentration of the administrative and financial responsibility in a "board of directors" composed of 12 industrial executives.

Name Five Objectives

The objects of the association, as stated in the new constitution, will be:

1. To provide systematic means by which organizations engaged in industrial standardization work may cooperate in establishing American standards in those fields in which engineering methods apply, thus avoiding duplication of work and the promulgation of conflicting standards.

2. To serve as a clearing house for information on standardization work in the United States and foreign countries.

(Concluded on Page 41)

The Challenge To Design

Editorial

AMERICA'S present march toward higher standards of living presents an unparalleled opportunity for the study of economic forces. Never before has a nation accumulated vast wealth so rapidly, distributed its benefits so broadly or afforded its people such an abundance of creature comforts as are enjoyed today.

Investigators seeking to ascertain what is responsible for this amazing condition do not proceed far without recognizing the important influence of machinery. It is difficult, if not impossible, to name a single eddy in the daily current of modern life that is not affected in some way by the application of machines.

And yet it is likely we have barely scratched the surface in utilizing mechanical devices. Thomas A. Edison declared recently that mechanization still is in its infancy. It would seem, therefore, that instead of having entered the machine age, we are now at its threshold.

This means increased responsibilities and broader opportunities for manufacturers of machinery. Already traditional conceptions regarding the invention, development, production and sale of machines are being modified. The idea that these functions may be carried on independently rapidly is being abandoned in favor of a policy of co-ordination, whereby they can be applied more intensively. Here, as in all branches of industry, improved organization appears to be the secret of success.

Manifestations of these new developments are appearing in machine design. Barriers that have existed for many years are being broken down to afford the profession more freedom of action. Those responsible for design are beginning to scan the broad horizon of industry for ideas. Every day additional materials, parts and accessories are made available for their selection and use. New methods of fabrication appear frequently. Experience of sales, repair and maintenance experts now is more accessible to the design department than ever before.

The outcome of these tendencies is that machine design becomes the focal point of many activities. It is the clearing house where the fruits of discovery, invention and research meet the experience of applied mechanics. It is the agency by which these contributions are utilized to transform ideas into practical machines to meet the requirements of modern civilization.

This challenge inspired the conception of MACHINE DESIGN as a monthly periodical devoted to timely, useful information for engineers, designers and others who influence design. It is intended that the material in this and subsequent issues will assist the profession of machine design to capitalize more fully its new opportunities. If in the years to come, this magazine may become an important contributing factor in the advance of that profession, may render practical service to its readers and may stimulate the creative impulse in industry, then the aims of its publishers and editors will be fulfilled.

Introducing New Models

THUS far during 1929 those branches of American industry which rely largely upon production machinery, with few exceptions, have been operating at record capacities. This has stimulated the creation of new machinery. Thousands of manufacturers have been brought face to face during this period with the problem of deciding whether or not new models should be introduced or whether the company should continue with its current line of machinery.

Development and introduction of a new model —a procedure often involving an expenditure in excess of $100,000—should be authorized only after a careful analysis of the many factors involved. Those responsible for the decision should satisfy themselves that the new machine will do its work easier, better, more quickly, or more cheaply, and also that the demand for it will compensate the manufacturer adequately.

Strict adherence to this policy will save the machinery manufacturing industries millions of dollars annually. This is a subject in which machine designers should be vitally interested. It is not enough that the man who designs shall create a wonderful machine; it also is necessary that this creation be practical. Therefore, while the true designer must have and usually does have great pride in design for design's sake, it is essential also that he always keep in mind the practical aspects of the profession.

A Billion Horses—Are They Wild?

A Review of "Men and Machines" by Stuart Chase

By H. Cole Estep

"Men and Machines" by Stuart Chase is one of the notable books of the year. It deals in an unusual way with a subject in which all machine designers and engineers are interested. For this reason the editors have asked Mr. Estep, a member of the American Society of Mechanical Engineers and a director of the American Foundrymen's association, to prepare the accompanying special review. "Men and Machines" is illustrated by W. T. Murch. It is published by the Macmillan Co., contains 354 pages, and will be furnished by MACHINE DESIGN for $2.50 plus 15 cents postage.

MACHINE design is more than a matter of drawing boards, blue prints, and a slide rule. It transcends technical knowledge, and demands constructive imagination of a high order. The great designer has always in mind an ultimate purpose beyond the success of his creation from an engineering standpoint. His aim is to make a contribution to social progress.

Watt's vision was not a mere engine, but power harnessed for the welfare of mankind. The Wright brothers worked to develop a new method of transportation. Mergenthaler strove to perfect a machine to make education universal by bringing the printed word to every man. So on through the endless catalog of progress flowing out of engineering resign.

What then if this machine age of the twentieth century, ultimate flowering of the measureless effort of thousands of designers and engineers, is itself not worth while? What if in spite of our airplanes, machine tools, steamships, and typewriters we are no better off than were the people of the Middle Ages?

These are questions which some men are beginning to ask. Questions which strike at the very root of the whole career of every designer, and of every engineer concerned with development. They are serious questions, worthy of examination. It is not sufficient to brush them aside as trivial or irrelevant. As the creators of modern civilization engineers are willing to shoulder the responsibility which this implies.

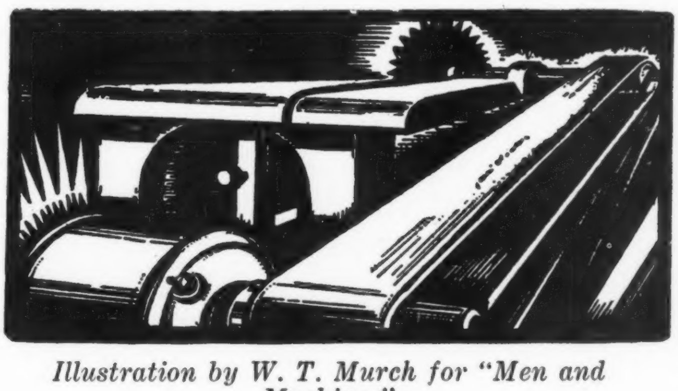


Illustration by W. T. Murch for "Men and Machines"

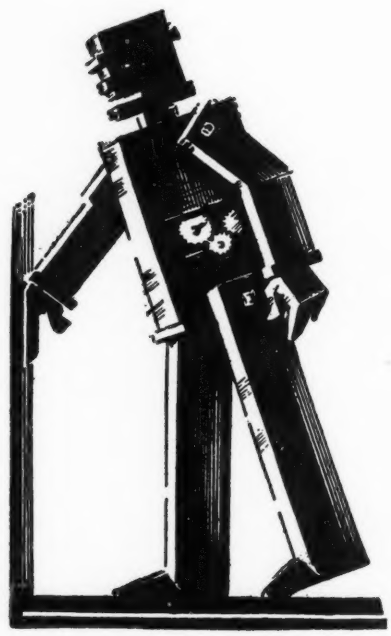
Designers and development engineers therefore will find much of interest in Stuart Chase's new book, "Men and Machines." It might bear the subtitle—"A Critical Examination of the Power Age." More conservatively written and balanced in its conclusions than *Your Money's Worth*, it can be said to be a really worth while study of the effect of machines on society, although most engineers will feel that some of the author's conclusions are too pessimistic and others even unwarranted.

"Certain philosophers," says Mr. Chase at the outset, "hold that machinery is enslaving us." On the whole *Men and Machines* seems to refute this statement. At least, Mr. Chase comforts designers with the thought that the trouble is not with the machines, but with the way they are used by human beings. He shows conclusively that few of us are being made robots by machines, as charged by some; he proves that skill is fostered rather than blighted by machine processes; he admits that labor is saved, although the sum total of work to be done in the world is increasing; he also admits that without machines our present world population could not be supported; he demolishes the cry of a few radicals who bewail the so-called standardization of modern society; and he proves that art and culture are not dead but much alive in this machine age.

Mr. Chase prefers to call it the power age.

In spite of the credit he gives the machine (and its designers) he has many misgivings. He bewails the flood of cheap and shoddy goods, for which he blames machine production. He predicts a "two hour war" with destruction unlimited. He talks of "leaning towers" and seems to be afraid machine civilization may somehow become so complex and top-heavy it may no longer function.

Whereupon we should all starve—except for a few favored souls who could go back to splitting bones and the primitive sanitation extolled by the late James Whitcomb Riley! He is afraid we shall not have any more petroleum in ten years, any copper in 1960, or any iron ore left for our grandchildren. In this respect an engineer, while deploring waste of natural resources, would point to the ratio between the consumption of raw materials and the total weight or volume of the earth's crust, even to a depth of only a mile. Chase says we have created a billion horses and they are all wild. Who, he wonders, will tame them.



The Mechanical Man—By W. T. Murch

But on the whole, he is not unhopeful. In conclusion he says: "Man is not the slave of his machines, but he has allowed them to run unbridled, and his next great task is, by one method or another, to break them to his service.... Where are the riders with their whirling ropes; where the light-hearted youths to mount, to be thrown, and rise to mount again?"

In several of its earlier chapters *Men and Machines* is a real text book for designers and engineers. From page 22 to 108 we find almost an engineering treatise under the captions: The Anatomy of Machinery; Machines of the Ancients; and From James Watt to the Mechanical Man.

Chase's definition of a machine is good, although an engineer would also differentiate it from a mere mechanical device. "A machine," he says, "is any nonliving contrivance to extend or modify the power of the body, or to refine the perception of the senses. Its commonest function is to transfer random energy into disciplined energy. It thus includes tools of all kinds, and mechanisms for more careful recording and measurement—the transit for instance, or the telephone receiver."

Further on in this chapter Mr. Chase presents a good analysis of prime movers and secondary movers, such as electric motors. "Are we likely," asks the author, "to see any new sorts of engines in the immediate future? Probably not. About the most valuable new engine imaginable would be one which could economically turn a large portion of the heat energy of coal directly into electricity, thus removing the boiler, the cylinder, and the dynamo from the picture altogether." Such a short circuit is not beyond the bounds of hope, thinks Mr. Chase.

In his analysis of machine functions Chase presents an interesting table comparing elementary machine movements with human body movements, or with body movements plus simple tool movements.

Following the analysis of machines, are two historical chapters which present an excellent survey of the development of engineering and machine design, from the machines of the ancients to the mechanical man, as Chase expresses it. In these chapters the author brings us down to the present day, winding up with an exceedingly good definition of mass production which he says is not sheer bigness and has nothing to do with financial consolidations, but means in the essence just two things: the making of standard interchangeable parts; and the assembling of these parts into a completed unit with a minimum of handicraft labor. In this connection Chase pays his respects to those who have been bewailing the loss of beauty and the decline of esthetic values due to standardized production.

"A standardized airplane," he says, "need send no hostages to loveliness. Her design and her medium call for the micrometer and the superlative finish of the grinding wheel. These can, if they choose, deliver a more just and lovely thing than craftsmanship could ever achieve."

After chapters devoted to vivid descriptions of the worst of the early days of the power age in England in the middle of the last century, and after demonstrating that few of us are going to be made robots by machines or lose our skill, Mr. Chase comes down to the question of whether machines save labor. He seems doubtful on this point, taking machines as a whole, though admitting that individual machines save quantities of labor.

"If wants," he points out, "expand as fast as

invention the standard of living rises, but all the labor that is saved in process A must go to work on process B—national advertising or the implacable Joneses having created a demand for B. The community as a whole labors just as hard as ever."

And then Mr. Chase refers rather wistfully to the Fourteenth century with its 160 to 180 holidays a year, although he has little to say about the serf who virtually was chained to the same square mile during his entire lifetime. One questions whether even Mr. Chase himself would care to go back to these conditions; mending his own shoes, sticking his own pigs, and canning fruit. If you think this is a soft job, ask your grandmother. The relative worthlessness of home brew compared with good factory-made Pilsner tells the story of the difference between a machine culture and a cottage culture.

Mr. Chase is also worrying over whether we are going to have so many machines that there will not be enough jobs to go around. He seems to embrace a little too readily the theory that the machine can be blamed for unemployment. "I am seriously afraid that accelerating unemployment is here," he says, "and that the park bench is destined to grow longer." But such is the tremendous energy of this country that in the few months between the time Mr. Chase was writing his book and the present we have been engulfed with such a huge demand that industry finds itself producing more than ever with the wants of the country apparently not fully satisfied. Unemployment is a dead issue for the time being along with profitless prosperity.

Chase gives considerable attention to industrial accidents for which inferentially machines are to blame. "The increased speed and use of mechanical processes has made for a greater accident rate in the United States since 1920," he says. He admits, however, that more recently industrial casualties have been coming down and mentions the Clark Thread Co. with its record of 10,000,000 man hours without an accident. He might have gone further and pointed out that probably about all that has taken place is a change in incidence and kind of accidents. There were quite as many casualties in former days. Among the accidents of olden times were the following: Burning at the stake; a throw from a horse; mangled by a bear; crushed by a 50-pound stone dropped negligently from the castle battlements; cut with an axe; falling into the well, etc.

It is toward the end of his book that Mr. Chase gets off the track from the machine designer's standpoint. His "two hour war" is a little short and there is no reason to worry over what he terms technological tenuousness. It is not true that a hundred men could stop the technical processes of a city like New York, if for no other reason than that a hundred thousand others would prevent them from doing so, or that at the very worst, essential functions could be kept going by volunteer labor from our technical colleges. Nor are the billion horses as wild as Chase would have us think.

Nevertheless and on the whole this is a book which can be recommended to everyone interested in machine design and engineering development. The earlier chapters dealing with the history and technology of the machine age are excellent. Few engineers will agree with all of the doubts expressed in the later chapters which deal with the social implications of the present power era. With all its faults most of us will go on being fairly well satisfied with our present type of civilization until the slow process of evolution has gradually produced something better.

New Status of Standards Work Will Benefit Design

(Concluded from page 37)

3. To further the industrial standardization movement as a means of advancing the national economy.

4. To promote a knowledge of, and the use of, approved American industrial and engineering standards, both in the United States and in foreign countries.

5. To act as the authoritative channel in international cooperation in standardization work, except in those fields adequately provided for by existing international organizations.

The directors of the association are Quincy Bent, vice president, Bethlehem Steel Co., Bethlehem, Pa.; G. K. Burgess, director, U. S. bureau of standards, Washington; C. M. Chapman, construction engineer, New York; C. L. Collens, president, Reliance Electric & Engineering Co., Cleveland; Howard Coonley, president, Walworth Mfg. Co., Boston; L. A. Downs, president, Illinois Central system, Chicago; Bancroft Gherardi, vice president and chief engineer, American Telephone & Telegraph Co., New York; F. E. Moskovics, president, Improved Products Co., New York; W. J. Serrill, Chemical Research committee, U. G. I. Co., Philadelphia; C. E. Skinner, assistant director of engineering, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; M. S. Sloan, president, New York Edison Co., New York; R. J. Sullivan, vice president, Travelers Insurance Co., Hartford, Conn.

Men of Machines

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

CHARLES PIEZ, chairman of the board of directors of the Link-Belt Co., who recently was nominated for president of the American Society of Mechanical Engineers, has been closely identified with the mechanical engineering profession for 40 years. Following his graduation from the school of mines, Columbia university in 1889, he entered the employ of the Link-Belt Engineering Co. in Philadelphia as an engineer draftsman at $65 a month. Seventeen years later, after he had advanced to the position of chief engineer and general manager, he was elected president of the Link-Belt Co., a consolidation of the Link-Belt Engineering Co., Ewart Mfg. Co. and Link Belt Machinery Co. He is director of several Chicago banks, a member of the executive committee of the Museum of Science and Industry founded by Julius Rosenwald, and an active member of numerous engineering societies.

* * *

Many important electrical inventions stand to the credit of F. A. Merrick, recently elected president of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. He has been vice president, general manager and director of this organization, and succeeds E. M. Herr, who filled the president's chair for 18 years prior to his resignation.

* * *

F. E. Moskovics, who recently was made a member of the board of directors of the American Standards association, received his technical education first at Armour Institute of Technology and then abroad. In 1907 he designed the Allen-Kingston, this being the first American car to complete with foreign cars in racing. In 1924 he became vice president of the Franklin Automobile Co., and one year later president of the Stutz Motor Car Co. He now is president of the Improved Products Co., New York.

* * *

Cloyd M. Chapman, consulting engineer, New York, who also is a member of the newly formed board of directors of the American Standards association, was graduated from Cornell university in 1898. He has since been prominent in the field of design and engineering, first entering the employ of Thomas A. Edison as assistant in his private laboratory. He has contributed many papers to scientific societies and the technical press.

* * *

Marcus T. Lothrop, recently elected president of the Timken Roller Bearing Co., Canton, O., started with the Timken company in 1911, as metallurgist. For the past 18 years he has been intimately connected with its affairs, occupying successively various capacities in metallurgy, research, in charge of operations, and vice president. He succeeds H. H. Timken, who has become chairman of the board.

* * *

The fact that 80 per cent of the airplane engines being built in the United States are of the air-cooled, radial type emphasizes the importance of the design of the first models of this kind by Charles L. Lawrance, who now is president of the Wright Aeronautical Corp., Paterson, N. J. Mr. Lawrance was educated at Yale university and L'Ecole des Beaux Arts. His first air-cooled radial engine was completed in 1914. He has made a thorough study of aerodynamics and designed an airplane wing section that was used during the World war.

* * *

The Glenn L. Martin Co., Baltimore has secured the services of A. J. Subasky, designer, who formerly was employed by the Poole Engineering Machine Co., Baltimore, as machine designer.

* * *

George E. Denis has been appointed chief engineer of the Universal Motor Co., Oshkosh, Wis. Previously Mr. Denis had been engaged in the design of engines for the Buda Co., Harvey, Ill.

* * *

Maurice A. Thorne, formerly superintendent of the proving ground of the Studebaker Corp. of America at South Bend, Ind., has joined the Pierce-Arrow Motor Car Co., Buffalo, as experimental engineer.

* * *

Kenneth M. Lane has been appointed chief engineer of the aeronautics branch of the Department of Commerce. Previously he held the position of chief airplane designer at Wright Aeronautical Corp., Paterson, N. J.


Leaders in Design, Engineering and Research
F. A. MERRICK
MARCUS T. LOTHROP
CHARLES PIEZ
CHARLES L. LAWRANCE
F. E. MOSKOVICS
CLOYD M. CHAPMAN

The Publisher's Mail Basket

THAT leaders of thought in the engineering profession recognize the need of a publication on machine design is clerly indicated in many letters received by the publishers of MACHINE DESIGN. Robert T. Kent, editor-in-chief of Kent's Mechanical Engineers' Handbook, lays particular stress upon the responsibilities of the designers of machinery. He writes as follows:

I have read with a great deal of interest the prospectus of MACHINE DESIGN. It is a most ambitious project, and, if carried out according to the scheme outlined, one of great value not only to the engineering profession, but also to all the people in every walk of life.

"Machine Design" is an all-embracing title in this age of machinery. Practically everything that makes for our comfort, welfare, or happiness depends in the first instance on the genius of the machine designer. If one will try to imagine the chaos that would result if all the products of the machine designer were suddenly swept out of our present day civilization, he might have some conception of the importance of the work that you have undertaken. Conceive, if possible, what life in the year 1929 would be if our railroads, telephones, automobiles, electric lights, water supplies, heating and sanitation in our homes, and countless other necessities and conveniences that we take as a matter of course, were suddenly taken away from us. If one can conceive the picture above outlined, he will have an idea of the importance of machine design to civilization.

As I read the plans and specifications for MACHINE DESIGN, you are undertaking to make the work of the machine designer more fruitful, more accurate, more productive. And therein lies your responsibility. If you fulfill your misson as planned, then the machine designer will look to you for guidance. Just in that degree that your work is accurate, fruitful, and productive, so will his work be. Just in that degree that you fail to stimulate him to better and more accurate work, to that degree will he fail to give to his fellow men the full measure of his ability.

Civilization has progressed to its present high stage by the substitution wherever possible, of the machine for the man. The more machine power can be substituted for man-power, the more profitable will be the labor of man, and the more leisure will man have in which to enjoy those profits. The twelve-hour day was common in factories and workshops within the memories of men still living. The improvement in machines and their wider adoption, brought about successively the ten-hour day and the eight-hour day, and now the five-day week is looming on the horizon and possibly not far distant. In the last analysis, machinery and the machine designer are responsible for this amazing advance.

I can imagine no greater satisfaction in life than to play a leading part in the development of the science and art that have so much contributed to human happiness. And therefore, as MACHINE DESIGN fulfills its appointed mission will be derived that supreme satisfaction that comes only from the knowledge of a good job well done.

Very truly yours,

ROBERT T. KENT

H. A. S. Howarth, vice president and general manager, Kingsbury Machine Works, Philadelphia, welcomes the advent of a publication on machine design, as witness these words from a recent letter:

"The writer has often wondered why there was not a publication primarily adapted to the needs of the designer of machinery. Now that you have undertaken to satisfy this need, which has undoubtedly been felt by thousands of other engineers, we would be ungrateful to say the least if we did not go out of our way to assist you in every practicable way. You may therefore count on our cooperation."

Letters received from professors of engineering at many universities express the thoughts of this important section of the profession. The following, from a professor at the Rensselaer Polytechnic institute, is typical:

"I am of the opinion that this magazine will find a place among our engineering publications which has neretofore been rather barren and hence will find a hearty welcome from the profession."

Great interest in MACHINE DESIGN is being displayed by research engineers. This is indicated by the following abstract of a letter from the director of the Electric Steel Founders' Research group:

"I have examined the prospectus with considerabe interest. And I tender my congratulations in advance on what appears to be a very useful magazine covering a specialized field of great interest to designers."

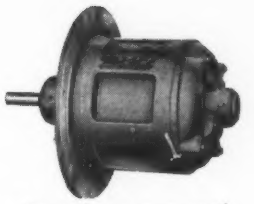
Manufacturers of machinery of all descriptions are confident they will derive much benefit from the publication. The following is abstracted from a letter received from the vice president of a textile machinery manufacturing company:

"We believe that this publication will be of material benefit to us as manufacturers of textile machinery."

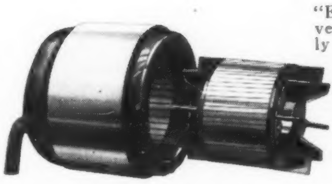
The general interest which the announcement of MACHINE DESIGN has aroused is expressed briefly in this abstract:

"I will look forward with great pleasure to receiving copies of this book and in watching it develop. It seems to fill a needed field and I am sure that the progress will be steady from this time on."

"Explosion-proof" self-ventilated motor specially constructed for use in dry cleaning rooms and other hazardous industries.

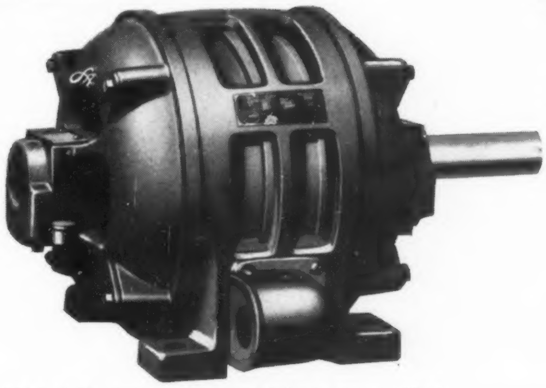


Flanged motor as used for direct mounting on drills, honing machines, etc.

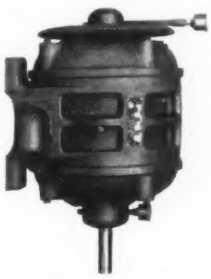


Shaftless rolled shell type motor for "built-in" construction. Used in machine tools, woodworking machinery, etc.

Crane motor with machined pads and double shaft for mounting brake, and with navy type front head.



Multi-speed motor (simple squirrel cage type). Used wherever 2, 3, or 4 definite speeds, instantly available, are required. Typical applications include machine tools, woodworking machinery, bakery machinery, etc. Eliminates speed changing gears and clutches.



Vertical motor with mushroom cover. Without base but with feet for mounting direct on side of open-top extractor

Vertical motor with mushroom cover and ring base. For mounting direct on open-top extractor.

"Custom-built" Motors Make Good Machines Better

No matter how *good* a machine may be, in itself—no matter how precise the design, nor how exact the performance of each part—its actual efficiency depends largely upon its motors. Machine excellence can be protected and enhanced by scientific motor application.

L.A. "custom-built" motors are furnished with whatever unusual features are required—to produce the high efficiency and exact performance expected of a modern production machine. Sometimes this means a motor with special mounting features to eliminate unnecessary parts and to make the machine more simple and compact—or it may mean unusual construction of the entire motor to meet some peculiar operating condition—and sometimes the motor must be built with unusual torque characteristics to enable the machine to perform with an exactness that is impossible with an ordinary motor.

Such features of L.A. "custom-built" motors reflect utmost refinement in machine design. They make *good* machines *better*. That is why both users and manufacturers are realizing more and more—that machines do their work better—and are more saleable—when "L.A. equipped."

For Greater Machine Efficiency—Specify L.A. Motors

Prompt Deliveries *Bulletins on L. A. "Custom-built" motors will be sent you on request.* **Nationwide Service**

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Scanning the Field for Ideas

A Monthly Review of New Machinery with Special Attention to Significant Trends in Design

A DEVELOPMENT in design of machinery worthy of much consideration is the introduction of many electrical devices for inspecting, registering and so forth. Electricity, in its connection with machinery, has been looked upon chiefly as a means for applying power, or for the generation of heat. That it may be utilized in many other ways however, is being more fully recognized as new applications are conceived and successfully exploited.

Employs Electricity in Scale

The Telepose, a scale used for continuously weighing material in transit on a conveyor, is an interesting example of this trend toward the increased use of electricity. This scale has been developed by John Chatillon & Sons, New York. Details of its construction are as indicated in Fig. 1. Within the main frame, suspended by yokes from multiplying levers, is a rectangular frame upon which are mounted two carrying idlers; the belt with load upon it passes over these idlers. Check rods attached at one end to the main frame of machine maintain the rectangular suspended frame in correct position.

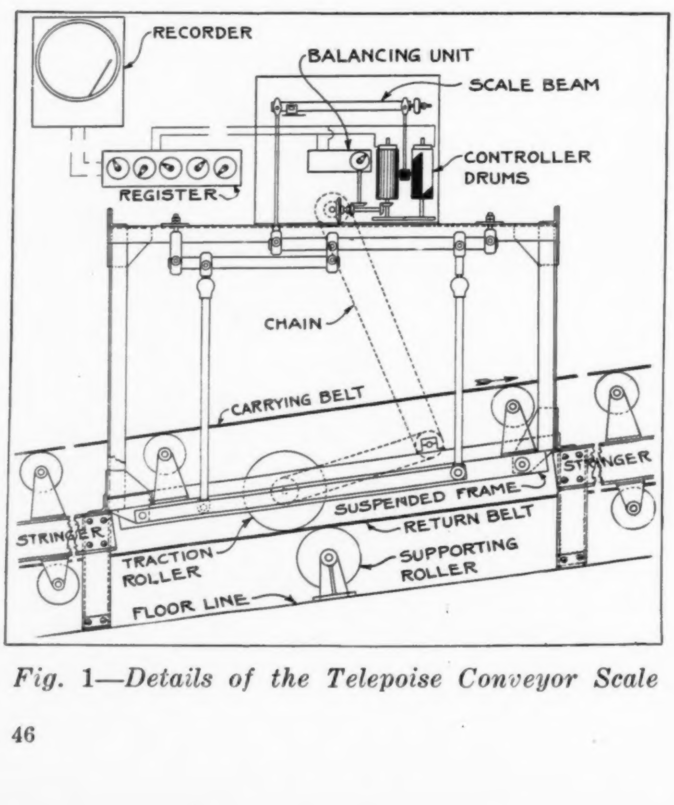


Fig. 1—Details of the Telepoise Conveyor Scale

To obtain the weight of a continuous flow of material on the conveyor belt it is necessary to combine the size of the stream with the speed at which it moves. To accomplish this a traction roller which is rotated by its weight resting upon the inner surface of the return belt is connected by chain drive and gears to two serrated controller drums, as shown in illustration; the surface of one controller drum is milled into a succession of equal cams which as the drums revolve impart a rapid vibrating movement to a contactor suspended from the end of the scale beam. The contact drum on the right has a surface one half of which is electrically conductive and the other half insulated. Both drums are in an electrical circuit but insulated from each other; circuit is completed only when the contactor is vibrated against the conductive surface of the contact drum.

How Scale Is Calibrated

The scale is calibrated so that with no load on conveyor the contactor is at the bottom of drums and misses the point of conductive surface. At full load the contactor is at the top where it is vibrated continuously against the conductive surface which at this point encircles the drum completely. The electrical impulses obtained operate an electromagnetic device similar to those used in stock-tickers, fire alarms, etc., which is geared to the register at the correct ratio to convert the contacts into such units of weight as desired to show on the registering dials. Thus if 800 contacts are made by a ton of material passing over the conveyor, a half ton would produce 400 contacts and register accordingly.

Besides other interesting features the machine has a three pen recorder of the familiar type operated by a clock which shows the amount carried on the belt during any specific period.

Proportioning Controlled By Electricity

Combination of electricity and mechanical motion of a somewhat similar nature is incorporated in an electromagnetic chemical proportioner re-

cently developed by the Paige-Jones Chemical Co., Inc., Hammond, Ind. Fig. 2 shows the proportioner and the water meter used with it. The proportioner may be mounted on top of a chemical tank, with the meter some distance away. The amount of water supplied through the meter to a softener controls the volume of chemicals introduced, and a fixed ratio thus is maintained. Two fiber cams *A*, shaped like ratchet wheels with coarse teeth, are fastened on the meter shaft; the spring contacts *B*, which are used for opening and closing an electrical circuit, bear on these cams. The cams have the same number of teeth, but are staggered on the shaft so that when the upper contact spring meets one of the sharp depressions in the top cam it drops abruptly and by making contact with the lower spring

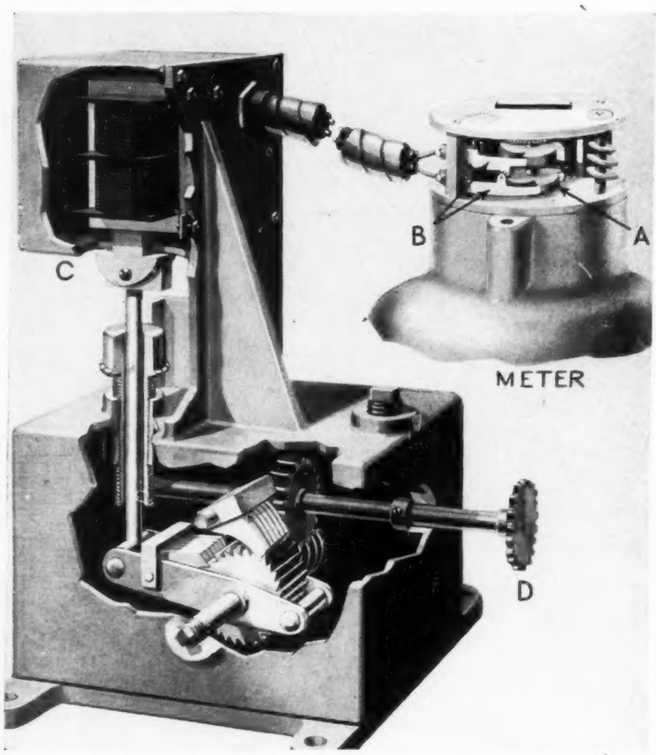


Fig. 2—Electro-magnetic proportioner for maintaining fixed ratio of chemicals and water

closes the electrical circuit; the circuit is broken again when the lower spring in turn meets the depression in its cam and drops away from the upper spring. A number of quick makes and breaks proportionate to the amount of water measured by the meter thus is obtained.

Transfer of these electrical impulses into mechanical motion which will regulate the chemical feed is accomplished by the electromagnetic unit *C* shown at the left in the drawing. This unit consists of a solenoid having an armature connection with a ratchet and a gear train. Each time the circuit is completed by the springs at the meter the solenoid is energized and pulls up the armature through the coil, drawing with it the armature extension which is connected at the bottom to a rocker arm having a series of pawls in engagement with a ratchet wheel. The speed with which this ratchet wheel is rotated thus is governed exactly by the amount of water fed to the softener.

Rotation of the ratchet wheel, working through a worm and gear, actuates a chain sprocket on the outside of the case. The chain on this sprocket is attached at one end to a counterweight and at the other to a swivel take-off pipe in the chemical tank. Each time the solenoid and ratchet mechanism functions, a proportionate turn is given to the chain sprocket; the take-off pipe thus is lowered by degrees into the chemical tank and maintained at the top level of the chemical charge until it is exhausted. The take-off pipe leads to the suction of the pump which forces the chemicals into the top of the softener.

For the purpose of obtaining accurate adjustments between the amount of chemicals required for a given quantity of water, a vernier is provided on the extension of the armature shaft; this regulates the length of stroke of the armature extension and the consequent movement of the ratchet wheel.

Universal series motors, the speed of which varies in accordance with load applied, are being used on various new machines. An interesting example is furnished by the bar stock cutting-off machine which was announced recently by the Oster Mfg. Co., Cleveland. The machine is of the revolving head, two-blade type and is powered with universal motor operating on 110 volt, single-phase circuits from 25 to 60 cycles, or 110 volt, d. c. Selection of the universal type motor for this machine was made chiefly because its speed is governed by the load put on the machine. The load being lighter as the tools approach the center of the bar being cut off, the motor increases its speed; this tends to give the tools a constant peripheral speed throughout the cut. Return of the blades for the next cut is at the highest speed of which the machine is capable.

Frame of 1000-Ton Press Arc-Welded

A distinct departure in the design of machine frames is indicated by the welded steel construction shown in Fig. 3. This shows the construction of the double C frames of a 1000 ton capacity press manufactured by the Pacific Steel Boiler Corp. with arc welders built by Lincoln Electric Co., Cleveland. Three double C frames are incorporated in this press, each frame consisting of eight ½-inch plates, 14 feet high and 7 feet 6 inches wide. In building up the three laminated

frames, studs ⅞-inch in diameter were placed as shown in sketch with hexagon nuts so located as to space the inside plates 4 inches apart. The plates were held in position successively by bolts during the welding process, and the bead chipped flush with the surface before the next plate was put in place.

Visible and Variable Feed Provided in Lubricating System

Improved methods of lubrication are being introduce rapidly, and already many machines are equipped with automatic lubrication systems. In this connection the individual oil feeders shown in Fig. 4, are of interest. These feeders are furnished with the Blanchard pulsating lubricating system which consists essentially of an oil reservoir, pump, pressure control valve, single circuit pipe line and feeders.

Individual feeders may be provided at each lubricating point of a machine. They are made in a variety of forms to facilitate application and piping arrangements. It will be noted from the drawing that the oil, in circulating along the pipe line *A A*, passes through the feeder at *B*. It flows at low pressure except when pulsation occurs through the control valve. At this time the momentary kick of the oil lifts the adjustable needle *C* from its seat, admitting a drop of oil to the chamber *K*. As the oil collects, it flows down the passage *F* to the nozzle, *G*. A glass is provided at *H* through which the drips from the nozzle may be counted, and any necessary adjustment of the flow can be made through the screw *E*.

The opening for the oil feed at *J* has been provided purposely at the top of circulation line to obviate the admission of foreign substances with the oil; these travel with the stream to the filter furnished in the reservoir of the system.

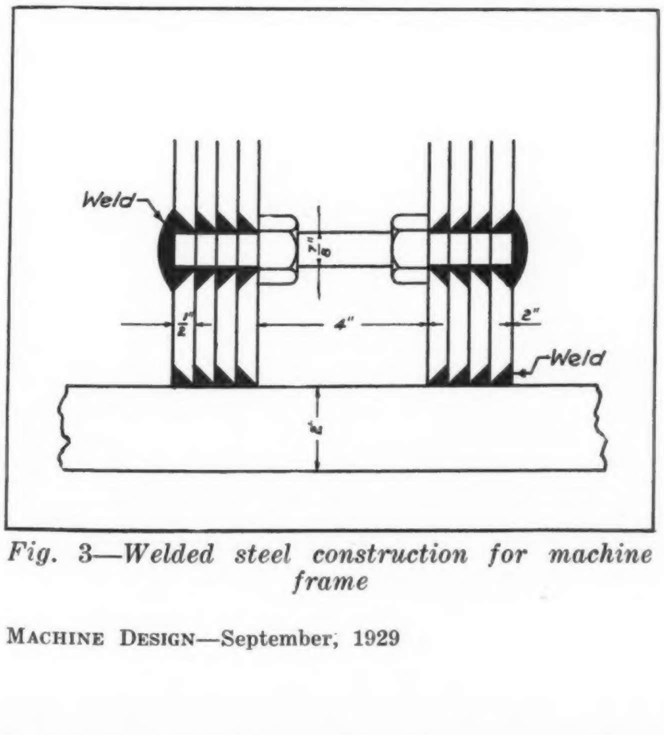


Fig. 3—Welded steel construction for machine frame

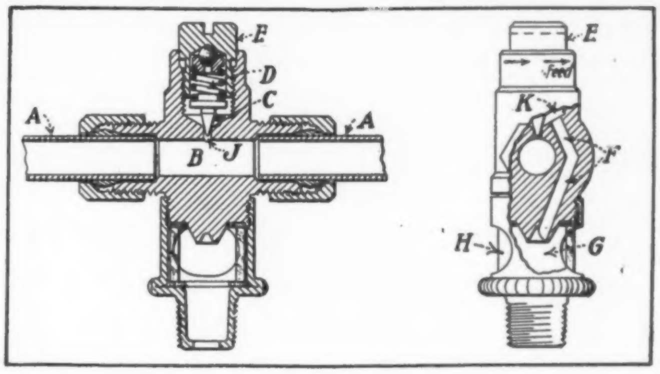


Fig. 4—Sectional views of automatic lubrication feeders

Hydraulic Brake Offers Possibilities

Though hydraulic brakes are not new there is much to be said for the construction, operation, and possibilities of a hydraulic auto brake manufactured by F. L. Barris of San Francisco. This brake takes the form of a rotary oil pump of the sliding blade type on which the blades may be withdrawn or released as required. The pump is keyed to the drive shaft of the machine or automobile. When braking action is desired a control valve in the short oil circuit is closed and the blades of the pump released, thus creating a definite retarding action on the shaft by excessive back pressure in the pump.

Another Field Invaded By Antifriction Bearing

The field of application of ball and roller bearings still continues to expand, one of the latest machines to be equipped with roller bearings being a gravel washer manufactured by the Smith Engineering Works, Milwaukee, Wis. This is by no means a simple application, an essential portion of the machine consisting of a ball mill scrubber which employs coarse rock as a grinding agency. Obviously it is necessary in such applications to protect the bearings as much as possible and this the designers of the machines provide for by furnishing suitable guards and shaft shields at the bearings.

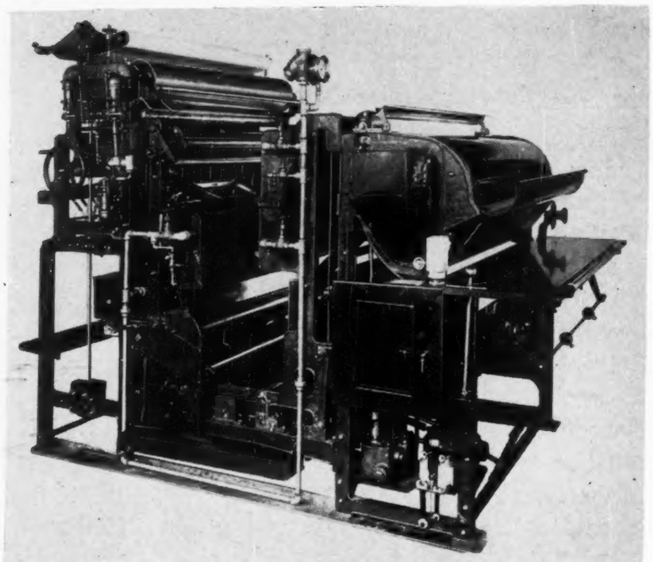
Double Eccentric Used for Adjustment

Mention should be made of the "Jigger" screen manufactured by the Productive Equipment Corp., Chicago. This screen is of the vibrating eccentric throw type, the screen body being mounted on rubber discs secured to a tiltable framework. For various types of service it is necessary to change the degree of screen vibration, which may be done at will be varying the eccentricity; this is accomplished by rotating the eccentric upon the drive shaft, which itself is eccentric. Thus it is possible to adjust for any degree of eccentricity within the total range.

Blue-Print Machine Has Improved Washing Device and Control

A NEW machine for producing blue prints, negative prints and blue and brown line prints has been announced by the C. F. Pease Co., North Franklin street, Chicago. It is known as the Peerless Model 30.

Following the usual practice, tracings are laid face up on a continuous roll of paper and are



carried around a semicircular segment of French plate glass past a bank of arc lamps. After exposure, tracings are returned automatically into a tray while the prints are carried through the machine for washing, potashing and drying.

The machine is equipped with a four-point, auto-type gear shift providing for two forward speeds, high and low, also neutral and reverse. This gear, which is a new departure in blue-print machinery, permits the operator to withdraw tracings or run back the leader roll when desired. A speed control in the form of a hand-operated dial connected to a rheostat permits instant change of printing speed.

A specially atomized wash consists of spray jets directing water over both surfaces of the paper. After washing, the prints come in contact with a 4-inch rubber-covered roll which applies a uniform coating of potash solution. Negative solution may be applied by the same roll, and interchange of solutions is a simple matter of feed tank adjustment without danger of dilution.

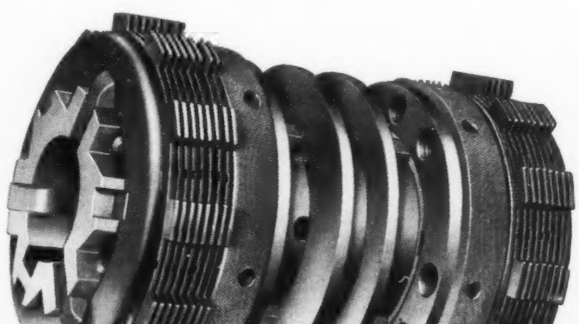
After a second washing by a spray jet arrangement, the paper enters the dryer, which consists of two chromium plated copper drums and an air drying unit. These units are in graduated heat arrangement and because of the direct roll contact, prints are dried free from wrinkles. A felt roller ironing attachment may be employed for thin paper.

The machine has a maximum production of 12 feet per minute. The printer can be operated separately from the washing and drying machine by means of a clutch adjustment. It can be purchased separately if desired. Model 30 is made in 42 and 54-inch widths either 110 or 220 volts direct current or 220 volts alternating current. The 42-inch machine has six lamps and the 54-inch machine seven lamps of the enclosed arc type which consume 6½ amperes on direct current and 7½ amperes on alternating current when adjusted for effective printing.

Designs Multiple Disc Clutch

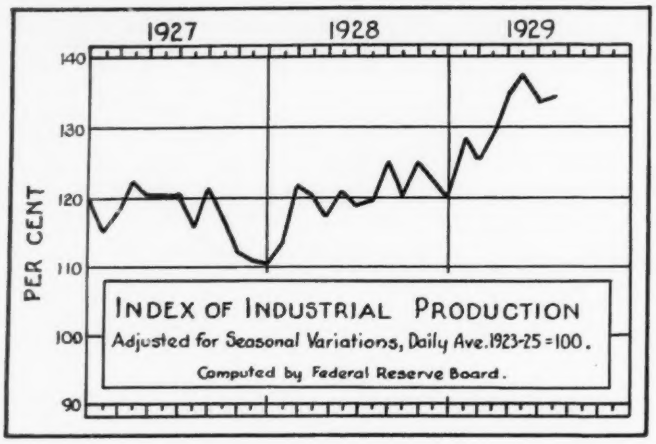
Many years of experience in the manufacture and adaption of multiple disc clutches have resulted in a new design, known as the C. C. type, announced recently by the Twin Disc Clutch Co., Racine, Wis. This clutch runs either in an oil spray or bath and centrifugal force operates to release the friction plate pressure levers, which are housed in the hub of the clutch. The pressure levers are operated by sliding wedges which also are guided and housed in the hub.

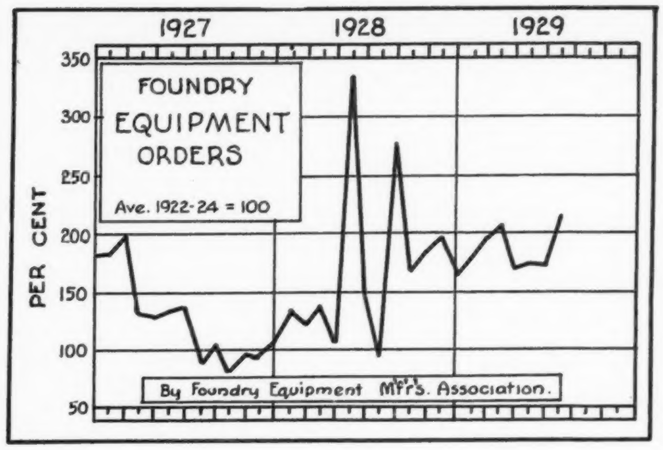
No cotters or similar parts are used in the assembly and, when installed, the clutch is free from projecting surfaces. The clutch will be produced



in sizes from 3½ inch effective diameter of friction discs up to 12-inch effective diameter.

The Rome Iron Mills, Inc., announces that it has leased its plant at Rome, New York, to the Wrought Iron Co. of America. The mill organization has been retained and the Wrought Iron Co. of America proposes to continue the production of high quality iron, as in the past.





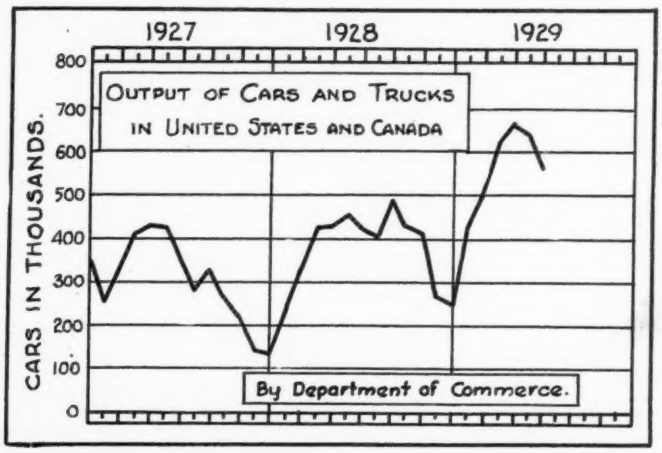
How Is Business?

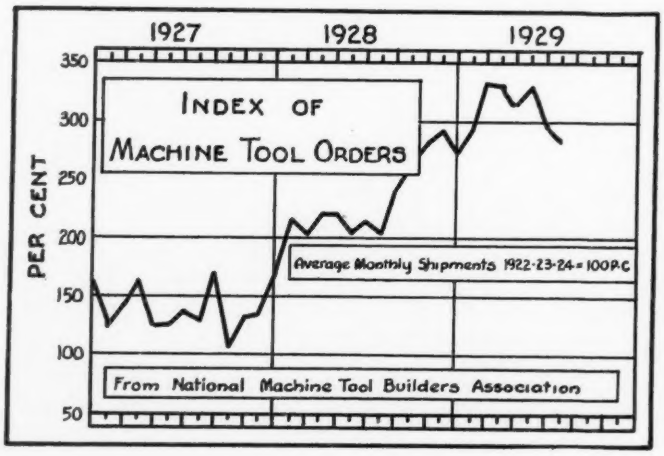
EMERGING from a summer season of unusual activity, general business now is swinging into the early autumn under decidedly favorable circumstances. Production has held to high levels and distribution and consumption have kept pace with it. The flow of goods has been stimulated by high rates of employment in many industries. Fortunate changes in crop prospects have added an amount estimated at one billion dollars to rural purchasing power. In spite of record-breaking industrial activity, there are no signs of excessive inventories—a healthy condition.

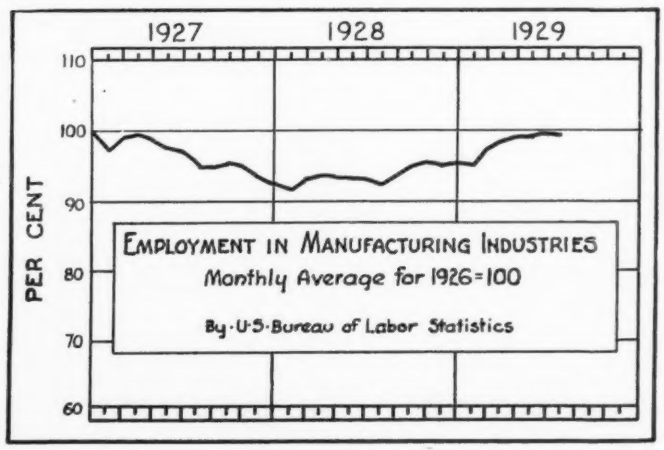
Conditions in the general manufacturing field are reflected in the accompanying charts. It is significant that in these barometers of business the trend lines in 1929 are higher at this time of the year than at the corresponding periods in 1927 and 1928. The production of steel ingots—a reliable indicator of manufacturing activity—has held up to record levels.

In the first seven months of 1929 the output of motor vehicles was 43 per cent more than in the same months in 1928. August production, while below the spring peak, probably exceeded that of July. Orders for machine tools, as revealed by the chart, have receded slightly from the peak, but the decline came two months later than the seasonal let-up normally appears. Orders for foundry equipment in July stand at the highest point for that month since the figures have been compiled.

On the whole, business in passing from the summer with less than customary seasonal slacking and the approach of fall promises to bring the usual quickening of activity.








ADD STRENGTH
Holding 88 spindle bearings, this Gunite plate for a multiple drill maintains its shape without "crawling"—and its size—to assure accuracy within .001 of an inch. It is a typical example proving the strength and rigidity of Gunite.
ADD WEAR
The slow, even wear of Gunite—its strength—and the ease with which intricate shapes can be cast recommend Gunite for cams and gears. This combination is a standard part on a Barber-Colman Automatic Spooler.
GREY IRON
STEEL
GUNITE
Graphite prevents scoring and tearing of ferrous metals under friction—but graphite is weak and causes brittleness when it arranges itself in veins as it does in cast iron. Thus it is clear why GUNITE is tough, though wear resisting, for the short, fat flakes of graphite in GUNITE leave the ferrous matrix unbroken.
without adding weight
ADD strength to back up the speed demanded by machine users today . . . add wear to guarantee continued satisfaction . . . through the use of Gunite.
Gunite . . . the new Graphitic Steel is stronger, absolutely rigid under vibration, will hold its shape and its size through years of trying conditions. It will modernize machines for present and future speed requirements without adding useless weight . . . without loss entailed by complete redesign and rebuilding to new patterns.
Gunite offers these advantages to you because it is new in characteristics . . . new in analysis . . . in distribution of elements, especially Graphite. It is cast to shape thus reducing the amount of material and machining required.
Investigate the possibilities of Gunite on all applications where strength, wear, uniform structure, or intricate shapes are required.
THE GUNITE CORPORATION
Rockford, Illinois
GUNITE
THE GRAPHITIC STEEL
(9914)

Review of Noteworthy Patents

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining To Design

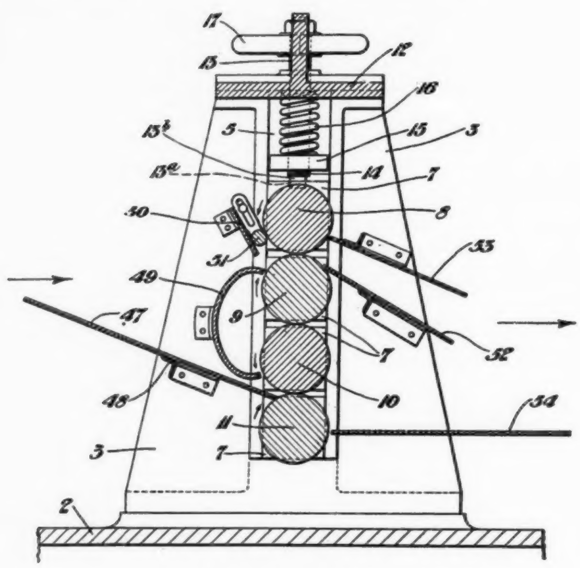
AMONG the patents for machines of unusual design or application issued recently by the United States patent office is No. 1,-724,849 for a pack-opening machine. It affords an excellent illustration of the adaptation of machinery to operations which heretofore involved disagreeable manual labor.

In his application, George M. Mowl, the inventor, states that the machine is designed primarily "to open packs of 'stickers' in making sheet and tin plates. In rolling tin bar into tinplates two short pieces of bar are placed one on top of the other and are rolled to a predetermined width, length and gage. The resultant product from this operation is designated as a 'pair' and is next doubled upon itself so as to have four thicknesses of metal and is again rolled, the resultant product being known as a 'pack.'

"The pack is sheared along its edges to make four sheared sheets, and the pack is then separated into individual sheets. Frequently the sheets stick together, in which case a workman separates one corner and by placing his foot on some of the plates and pulling on the upper one with a pair of tongs, frees the top plate from the others. Sometimes, however, the plates stick so tightly together that workmen cannot pull them apart, and it has been the practice heretofore to lay aside such packs, known as 'stickers,' so as not to interrupt the usual operation of the mill. These stickers later were separated by other workmen with special tools."

The machine patented by Mr. Mowl provides means for readily separating stickers with a minimum of expense and labor. It consists primarily of four rolls, 8, 9, 10 and 11, all of which are of the same size and are meshed so as to positively drive all rolls at the same speed; a clutch arrangement which permits instant reversing of the rolls; an entrance guide plate 47; a combined guard and separator plate 49; and other appurtenances.

The method of reversing the rolls is described as follows: "The sprocket 34 and gear 41 are provided with clutch rims 42 and 43, respectively, adapted to receive and be engaged by a double-



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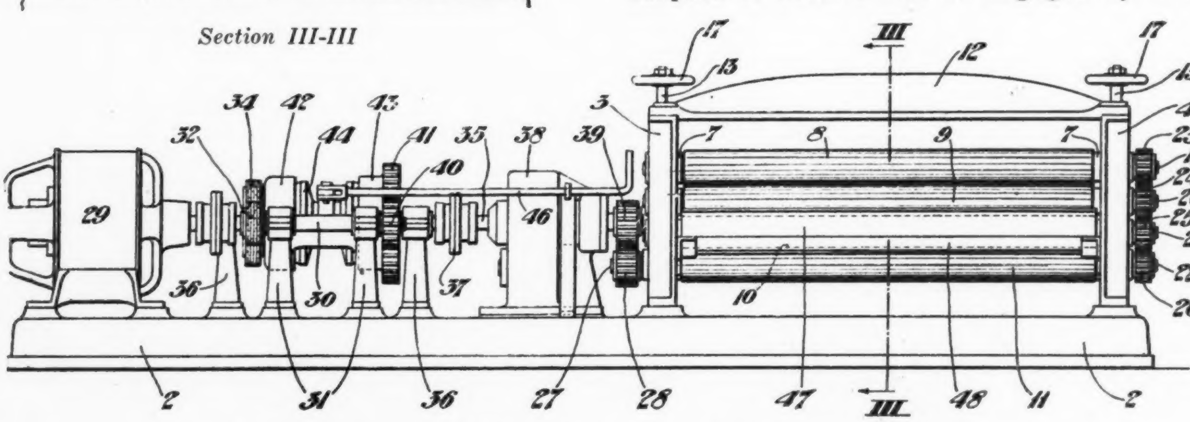


Cross-section and side views of pack-opening machine

Twin Disc Shows New Machine Tool Clutch

EVERY manufacturer and designer of machine tools is cordially invited to inspect a new Twin Disc machine tool clutch, to be exhibited at this year's Machine Tool Exposition.

This new Twin Disc product embodies the results of years of study and experience with machine tool clutch requirements. Its superiority in many important respects has been demonstrated in exhaustive tests made under the most difficult conditions that arise in practice. It is offered as a distinct forward step in machine tool clutch design and construction.

Full information can be obtained by visiting the Twin Disc exhibit at the Machine Tool Exposition or by writing to the address below. Ask for details of type C. C. Twin Disc machine tool clutches.

TWIN DISC CLUTCH COMPANY

RACINE WISCONSIN

faced clutch member 44 slidably mounted on the shaft 35 so as to be moved into engagement with either of the clutch rims 42 or 43, and held against rotation on the shaft by a suitable key.

"The sprockets 32 and 34 being connected directly by the chain 33 will rotate in the same direction as the shaft 30, while the gears 40 and 41 being meshed will cause the gear 41 to rotate in the opposite direction to the shaft 30 and pinion gear 40. Therefore, when the clutch member 44 is in engagement with the clutch rim 43 on the gear 41 the rolls will be operated in the opposite direction than when the clutch is engaged with the rim 42 on the sprocket 34."

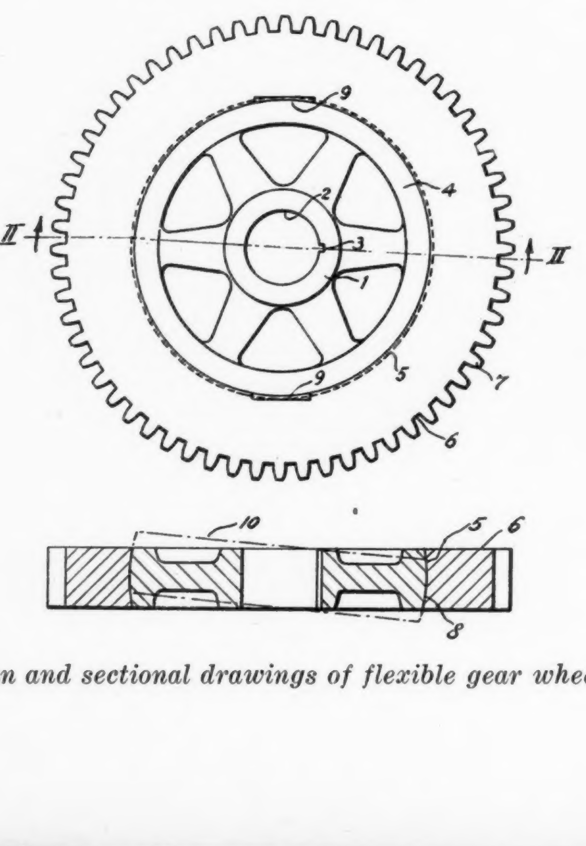
In operating the machine, the operator takes a pack of stuck sheets and opens one corner by pulling on the top sheet with a pair of tongs. After the corner of the top sheet is separated for a short distance, the pack is fed along the entrance guide plate 47 and the corner of the top sheet entered into the bite of the top pair of rolls 8 and 9, while the remainder of the pack enters the bite of the lower pair of rolls 10 and 11. The rolls then pull the sheet and pack through the machine, tearing the top sheet loose. The pack may be reentered as many times as necessary to separate all the sheets.

The patent, which was granted Aug. 13, 1929, has been assigned to the American Sheet & Tin Plate Co., Pittsburgh.

Review of Noteworthy Patents

Other patents pertaining to design are briefly described as follows:

GEAR—1,725,127, for a "flexible gear wheel comprising a hub and a rim having a spherically curved joint, and the latter having a plurality of slotted openings to permit extracting the hub from the rim member." Assigned to Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



Plan and sectional drawings of flexible gear wheel

ALLOY—1,726,489, for an alloy mainly of nickel and iron, containing at least two and one half times as much iron as nickel, also containing other elements. Assigned to N. V. Hybinette, New York.

GEARS—1,725,091, for method of producing hypoid gears. Assigned to Gleason Works, Rochester, N. Y.

SPEED-REDUCING GEAR—1,725,034. Assigned to Foote Bros., Gear & Machine Co., Chicago.

BEARING—1,724,902, for "a ball bearing having, in combination, two ball races, balls movable between the races, a stationary casing adapted to contain a supply of oil . . . arranged to permit the axial delivery by gravity of oil in restricted amounts to the bearing, and free axial return of such oil to the supply." Assigned to B. F. Sturdevant Co., Hyde Park, Mass.

TRANSMISSION—1,726,481, for variable speed transmission employing hydraulic principle. Assigned to Oilgear Co., Milwaukee.

TRAVERSING MECHANISM—1,725,274, for traversing mechanism for grinding machines. Assigned to Landis Tool Co., Waynesboro, Pa.

END BRACKET—1,725,784 and 1,725,806, for end bracket of welded construction for dynamo electric machine. Assigned to Lincoln Electric Co., Cleveland.

CONVEYOR—1,724,150 for a link belt conveyor. Assigned to Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.

FEED MECHANISM—1,725,444 for automatic feeding device for grinding machines. Assigned to Danly Machine Specialties, Inc., Chicago.

CONNECTING ROD—1,723,175, for a "master connecting rod for radial cylinder engines comprising a rod member and a separate bearing member for the crank end thereof, the shank of the rod member being I-shape in cross-section and the crank end being formed of two spaced annular plates constituting continuations of the shank flanges, the bearing member extending between and being supported by the annular plates tending between and being substantially unsupported between the plates." Assigned to the Wright Aeronautical Corp., Paterson, N. J.

LATHE ATTACHMENT—1,724,285, for a squaring attachment for metal cutting lathes. Assigned to the Seneca Falls Machine Co., Fitchburg, Mass.

FEED MECHANISM—1,724,047, for mechanism for rotating the back-lining feed roll gears of a book case-making machine. Assigned to The Smyth Mfg. Co., Hartford, Conn.

FEEDING DEVICE—1,724,259, for an apparatus for supplying abrasives to a plurality of sheet-surfacing machines, comprising a plurality of reservoirs, for different grades of abrasive, a conduit from each reservoir extending past the several machines, and back to the reservoir, means in each conduit for forcing the abrasive therethrough, and means adjacent each machine for selectively feeding abrasive to the machine from the conduits. Assigned to The Libby-Owens Sheet Glass Company, Toledo, O.

SAND MACHINE—1,726,504 for machine for screening, cutting, and handling molding sand. Assigned to American Foundry Equipment Co., New York.

METAL-WORKING MACHINE—1,726,376, for a metal working machine "the combination of a cut-off tool, a relatively movable stock bar holder, stock bar feed mechanism associated with said tool and holder, a main transmission for said machine, and a power train for the ac-

The Difference is in the feed

For Your Protection

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This trade-mark appears on the name plate attached to the pump unit of every *genuine* Oilgear Feed.

THAT new machine tool with Oilgear Feed . . you're greatly pleased with its work. "I never knew", you say to yourself, "that a machine could produce finished parts so rapidly without spoilage and tool breakage".

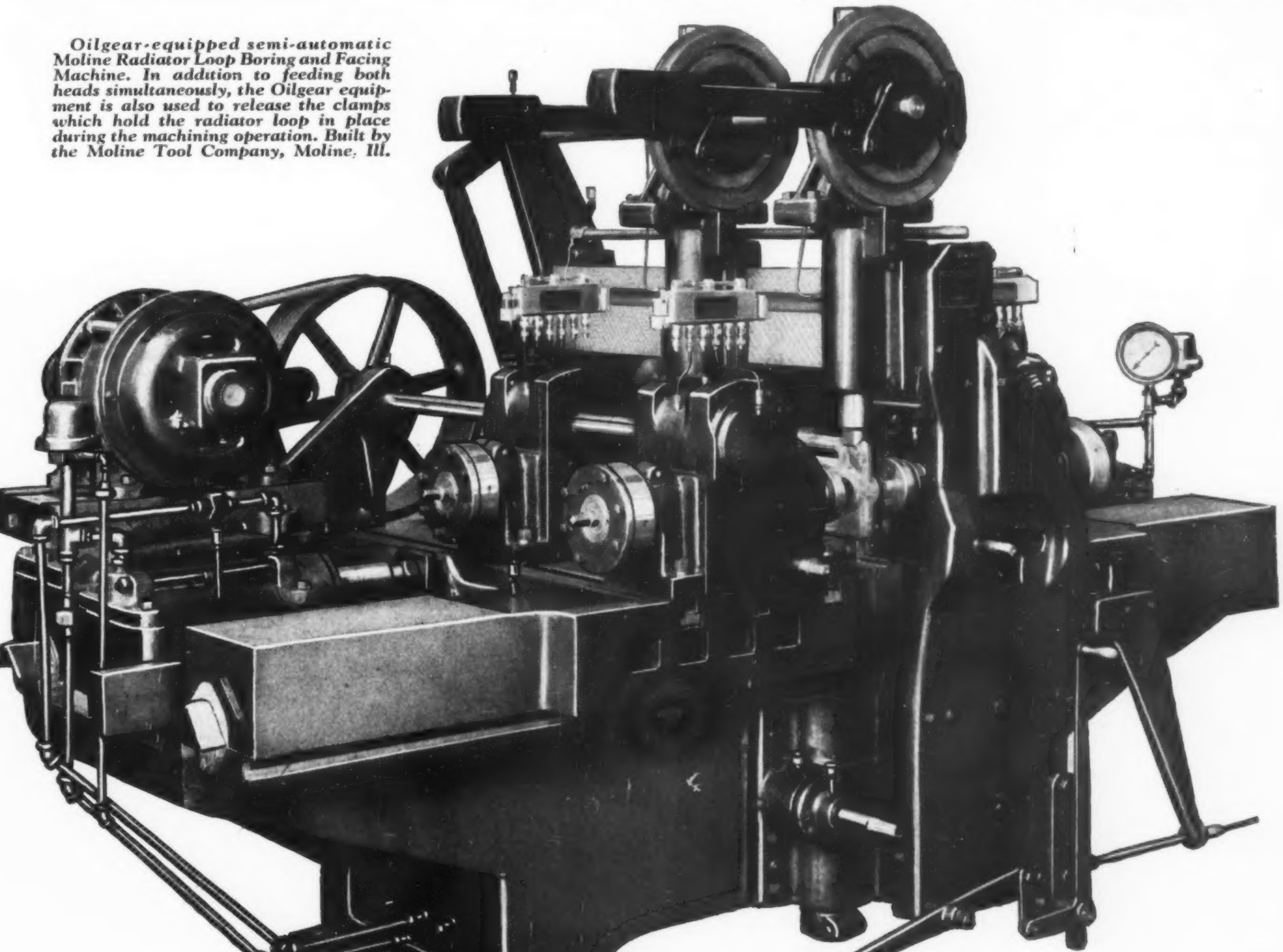
Ordinarily it couldn't. The same machine without Oilgear Feed and dependent upon mechanical feed would fall short of the performance that so pleases you. The difference is in the feed.

Because of Oilgear's cushioned power flow, there is no back-lash or chatter. The speed of feeding is vastly increased . . . is steplessly adjustable. Tool breakage due to faulty feed is entirely eliminated and production is accelerated.

More than seventy manufacturers of machine tools now feature Oilgear Feed. Specify it for the next machine tools you buy. It means increased production at less cost per finished piece.

The OILGEAR Company, 680 Park Street, Milwaukee, Wis.

Oilgear-equipped semi-automatic Moline Radiator Loop Boring and Facing Machine. In addition to feeding both heads simultaneously, the Oilgear equipment is also used to release the clamps which hold the radiator loop in place during the machining operation. Built by the Moline Tool Company, Moline, Ill.



OILGEAR

THE PERFECT MACHINE FEED

[8222]

tuating of said bar feeding mechanism and stock bar holder; together with automatic means adapted to interrupt said train without interrupting said transmission when the stock bar held by said holder has been substantially completely cut into work piece lengths by said tool." Assigned to Kearney & Trecker Corp., Milwaukee.

PACKAGING MACHINE—1,726,060. Assigned to Pneumatic Scale Corp., Ltd., Norfolk Downs, Mass.

SCORING MACHINE—1,725,967 for scoring machine for sheet metal. Assigned to American Can Co., New York.

TESTING MACHINE—1,725,892 for machine for testing tensile strength of metal rods. Assigned to Wyman-Gordon Co., Worcester, Mass.

GRINDERS—1,724,050. "In a swing-frame grinder, a grinding wheel, a hydraulic motor to drive said wheel, a hydraulic pump connected to said motor, means to drive said hydraulic pump, means to increase the stroke of said motor to increase the speed of the hydraulic pump and grinding wheel as the wheel wears down in use and means adapted to contact the grinding wheel and connected to said stroke changing means to prevent movement thereof to increase the driven speed of said wheel until the wheel has worn down in use." Assigned to the Diamond Machine Co., Providence, R. I. Another patent assigned to this company, No. 1,724,115 covers additional features of this speed control device.

GRINDING MACHINE—1,725,489, for hydraulic-actuated carriages on grinding machines. Assigned to Diamond Machine Co., Providence, R. I.

PULVERIZER—1,724,895, for single-zone pulverizing machine. Assigned to Riley Stoker Corp., Worcester, Mass.

WELDING MACHINE—1,723,984 for claimed features in a portable electric welding machine. Assigned to the American Electric Fusion Corp., Chicago.

BREAD-WRAPPING MACHINE—1,723,967. Assigned to the Wrap-Rite Corp., Chicago.

PIPE MACHINE—1,723,792, for a machine for drawing cast iron pipe from molds. Assigned to the United States Cast Iron Pipe & Foundry Co., Burlington, N. J.

LEATHER SPLITTING MACHINE—1,723,201, "in a machine for splitting leather, the combination with a member, having a fixed unyielding gaging edge, of a knife having its cutting edge situated closely adjacent said gaging edge, an internally-yieldable combined presser and feed roll situated to bear on the work at a point opposite the gaging edge, and means to rotate said roll first in one direction and then in the other. Assigned to the United Shoe Machinery Corp., Paterson, N. J.

CENTERLESS GRINDER—1,723,128 for a "centerless grinder including opposed grinding and regulating wheels and an intermediate work rest, a rotary carrier having a plurality of work supporting portions for successively presenting work pieces on the work rest between said wheels, and means for ejecting the finished work pieces." Assigned to the Cincinnati Grinders, Inc., Cincinnati, O.

MAGNETIC SEPARATOR—1,723,119 for a "feeding device and magnetic separator comprising in combination a feeding conveyor belt; a magnetic pulley supporting said belt; means for intercepting magnetic material freed from said belt as it passes off said pulley; and an intermittent drive for said belt." Assigned to the V. D. Anderson Co., Cleveland, O.

GRINDING MACHINE — 1,725,699, a machine for grinding hobs, worms, and the like. Assigned to Barber-Colman Co., Rockford, Ill.

GLASS WORKING MACHINE—1,724,677, for a machine for rounding the edges of glass by means of a grinding unit. Assigned to the Pittsburgh Plate Glass Co., Pittsburgh.

DIE CASTING MACHINE—1,724,332, for ten claimed features in a hydraulically operated die casting machine. Assigned to the Stewart Die Casting Corp., Chicago.

GEAR CUTTING MACHINE—1,724,241, for 28 claimed features in a machine for producing curved tooth gears. Assigned to Gleason Works, Rochester, N. Y.

Calendar of Meetings

Sept. 24-27—Illuminating Engineering society. Twenty-third annual convention at Bellevue-Stratford hotel, Philadelphia. Headquarters are at 29 West Thirty-ninth street, New York.

Sept. 25-27—American Drop Forge institute. Fall meeting at Buckwood Inn, Shawnee-on-Delaware, Pa. Donald McKaig, 1001 Union Bank building, Pittsburgh, is secretary.

Sept. 30-Oct. 4—National Machine Tool Builders' association. Second national machine tool exposition at Public auditorium, Cleveland. E. F. DuBrul, 1415 Enquirer building, Cincinnati, is secretary.

Sept. 30—Oct. 4—National Safety council. Eighteenth annual meeting at Chicago. William H. Cameron, 108 East Ohio street, Chicago, is managing director.

Oct. 2-4—Society of Automotive Engineers. Production meeting at Hotel Cleveland, Cleveland. Coker F. Clarkson, 29 West Thirty-ninth street, New York, is secretary.

Oct. 7-10—American Society of Mechanical Engineers. Third national fuels division meeting in Philadelphia. Calvin W. Rice, 29 West Thirty-ninth street, New York, is secretary.

Oct. 7-10—National Electrical Manufacturers association. Annual meeting at Wardman Park hotel, Washington. Albert Pfaltz, 420 Lexington avenue, New York, is secretary.

Oct. 23-25—Society of Industrial Engineers. Sixteenth national convention at Hotel Statler, Cleveland. George C. Dent, 205 West Wacker drive, Chicago, is secretary.

Oct. 24-26—American Gear Manufacturers association. Semiannual meeting at Benjamin Franklin hotel, Philadelphia. T. W. Owen, 3608 Euclid avenue, Cleveland, is secretary.

Nov. 4-7—National Association of Practical Refrigerating Engineers. Twentieth annual convention at William Penn hotel, Pittsburgh. E. H. Fox, 5707 West Lake street, Chicago, is secretary.

Nov. 19.—Foundry Equipment Manufacturers association. Fall meeting in New York. H. Cole Estep, 1213 West Third street, Cleveland, is secretary.

Dec. 2-6—American Society of Mechanical Engineers. Annual meeting at Engineering Societies building, New York. Calvin W. Rice, 29 West Twenty-ninth street, New York, is secretary.

Dec. 2-7—National Exposition of Power and Mechanical Engineering. Grand Central Palace, New York. Charles F. Roth, Grand Central Palace, New York, is manager.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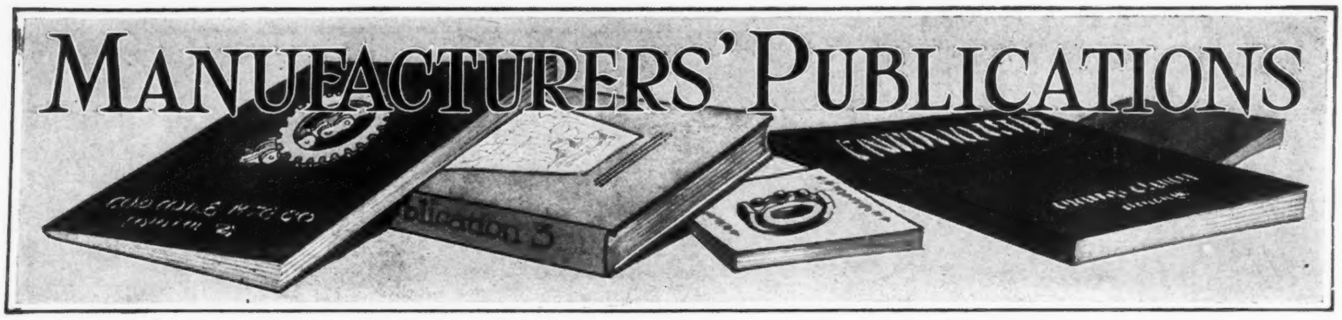

ELECTRIC CONTROLLER—An automatic brake-stop printing press controller is featured in a bulletin by the Monitor Controller Co., Baltimore. Illustrations show the entire mechanism, details of control and diagrams of floor and wall space occupied.

NICKEL ALLOYS—International Nickel Co., New York has just issued another edition of its buyers' guide for nickel alloy steel products. Producers of and dealers in more than 70 nickel alloy products are listed in this 12-page directory, which is corrected to July 1, 1929.

VALVES—A 52-page booklet recently was issued by the Homestead Valve Mfg. Co., Coraopolis, Pa. to illustrate and describe its line of valves for various industries. Suggestions as to the proper metals and designs for handling various liquids are given and specifications for numerous types of valves are presented.

TRANSMISSION AND CONVEYOR CHAIN—An 800-page book devoted to specifications and other data on power transmission and mechanical conveying equipment has been published by the Chain Belt Co., Milwaukee and the Stearns Conveyor Co., Cleveland. The products of the two companies described in the catalog include chains, water screens, power transmission, mechanical conveyors, and construction machinery. The merits of chain for these applications are set forth in detail and the subject of design is treated extensively. Attention also is given to operation and maintenance of chain equipment. The catalog is numbered 330.

PIPE FITTINGS—Circular 1676-B, issued by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., describes numerous fittings for pipe structures.

SPECIAL STEELS—In bulletin A issued in August, Duriron Co., Inc., Dayton, O., announces a new steel designed primarily to resist the action of hot, weak solutions of sulphuric acid. It is made in three grades know as Durimet A, Durimet B, and Durimet C. The bulletin gives the physical characteristics of the alloy, notes on machining, welding, heat treatment and available forms and data on applications to specific industries.

BRONZE PRODUCTS—Bushings, bars and bearings of bronze are described and illustrated in an exceptionally attractive catalog recently issued by the Johnson Bronze Co., New Castle, Pa. Application of these products in the automotive, railway, electric, metalworking machinery, construction, power, material handling, agricultural machinery and miscellaneous machinery fields are described.

SPECIAL STEELS—The Ludlum Steel Co., Watervliet, N. Y., recently issued a 32-page booklet on "Nitralloy and the Nitriding Process." Nitralloy is the name give to Ludlum steels of special analysis for use in the nitriding process. These steels are used for anvils, bushings, cams, chucks, clutches, cylinders, dies, gages, ring gears, spiral gears, timing gears, steering mechanisms, steam nozzles, pinions, wrist pins, spinning rings, rollers, camshafts, crankshafts, pump shafts, sectors and spindles. The booklet gives the analysis of Nitralloy and complete details of the nitriding process. The properties of nitrided case also are described.

CHAIN DRIVES—Under the title "Improving Power Transmission" in its catalog number 628, the Ramsey Chain Co., Inc., Albany, N. Y., describes its chain system of power transmission and presents illustrations and information showing applications for many types of machinery. The roller bearing joint which is a feature of this chain is given special attention. Many useful tables and suggestions for procedure in design are presented.

MOTORS—A 32-page booklet, entitled "Motor Drive for Metal-Working Machinery" recently was issued by the General Electric Co., Schenectady, N. Y. The various types of alternating current squirrel-cage and direct current motors are described briefly after which a two-page guide for the selection of the proper types for various kinds of work is presented. This guide is extremely practical, inasmuch as horsepower ratings for different sizes of many machines are tabulated. Magnetic control is described and many typical machine tools are illustrated.

ALLOY STEEL—Joseph T. Ryerson & Son, Inc., Chicago has issued a four-page folder devoted to "Nikrome", a chrome-nickel steel which meets S. A. E. specification 3140. It is suitable for conditions where mild steel will not stand up, as in heavy-duty axles, gears and pinions, bearing pins, bolts, studs, hook pins, etc.

COG BELTS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued a bulletin on cog belt drive for industrial purposes. Use of this form of belt for power application to various classes of industrial machinery is discussed and illustrations show the type of belt and typical installations. Compression, neutral and tension zones are described. Data for calculating a cog-belt drive are supplied and standard sizes for industrial service are shown in a table.

STEEL CASTINGS—Racine Steel Castings Co., Racine, Wis., has just published a 20-page booklet on basic electric steel castings. It illustrated the company's production facilities and describes the use of castings in freight cars, paper-making machinery, motor trucks, cranes, tractors, molding machines, generators, etc. The company's ability to furnish special alloy steels is explained.

ALLOY STEEL—Allegheny Steel Co., Brackenridge, Pa., has issued a bulletin on its Allegheny metal, a corrosion-resisting alloy containing 18 per cent chromium and 8 per cent nickel. The bulletin gives a table of results from application of corrosive agents, physical data and a list of uses to which it can be put in various industrial lines. Characteristics of the metal also are described.